THE FACTORS AFFECTING TRAJECTORY PROFILE OF SCP-A2 OFFSHORE JACKET DURING LAUNCHING FROM A TRANSPORTATION BARGE

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CIVIL ENGINEERING
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The Factors Affecting Trajectory Profile of BCP-A2 Offshore Jacket During Launching From A Transportation Barge

By

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Dissertation submitted in partial fulfilment of
the requirements for the
Bachelor of Engineering (Hons)
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CERTIFICATION OF APPROVAL

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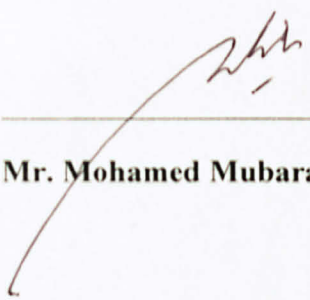
Approved by,



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July 2009

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgement, and that the original work contain herein have not been undertaken or done by unspecified sources or person

AINI ZALIHA ALIAS

ABSTRACT

Jacket structures are commonly used in shallow water regions. A jacket can be installed by lifting or launching from a barge into the water. As the jacket becomes heavier in its own weight, launching technique is preferred; economically. However on the other hand the procedure is too risky for the jacket's design life. The most important and critical stage in the launching process is when it is being separated from the barge; different barge trim angle will give various effects on reaction at rocker pin, time separation, mudline clearance and rolling of the barge. The purpose of this study is to investigate optimum condition during launch based on trajectory analysis result and to obtain main parameter that affects the jacket during launch from barge. Considerations on the cases concerned are possibilities of increase in friction on skid beam, shift in Center of Gravity, and changes in jacket's self weight. Analysis was performed using SACS software, shown no straightforward result for ideal barge trim angle for launching. Selection of the optimum condition for launch was based on engineering judgment to generate less reaction at the rocker arm beams, shortest time of separation, maximum mudline clearance and high buoyancy.

ACKNOWLEDGEMENT

I would like to express my sincere appreciation to my supervisor, Mr. Mohamed Mubarak for his encouragement, guidance, critics, and help throughout the whole period of this project. His support and advices are very much appreciated.

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LIST OF ABBREVIATIONS

AFT	-	After Draft
API RD	-	America Petroleum Institute Recommended Practice
COG	-	Center of Gravity
Cont.	-	Contingency
FYP I	-	Final Year Project 1
FYP II	-	Final Year Project 2
FWD	-	Forward Draft
MSC	-	Marine Structure Consultant
ONGC	-	The Oil & Natural Gas Corporation Limited
SACS	-	Structural Analysis Computer Software
SHI	-	Samsung Heavy Industries
w.r.t	-	With respect to time
WSD	-	Working Stress Design

CHAPTER 1

INTRODUCTION

1.1 Project Introduction

Platform structures are commonly utilized for various purposes including offshore drilling, processing and support of offshore operations. A jacket is a supporting structure for decks consisted of helideck, maindeck, mezzanine deck and cellar deck which are the facilities stabilized by leg piles through the seabed. The size of a jacket is dependent on deck size, foundation of seabed and the environmental loads.

Several analyses such as in-service condition including in-place, fatigue and earthquake analysis and pre-service condition including load-out, transportation, lifting, launching, floatation and upending, and on-bottom stability are performed to check the stability of a jacket.

A barge is used to transport the jacket to the installation area. Removal of the jacket from the barge is usually accomplished by either lifting with a derrick barge or launching. Basically the jacket will be lifted using barge crane from transportation barge into the water. This method is easier to be analyzed and economical. However, if the jacket weight exceeded the barge crane allowable lifting limits, launching will be the only option. A jacket which is transported by barge usually launched at or near the installation location. The jacket generally moved along ways, which terminate in rocker arms which is located at the end of the barge. As the position of the jacket reaches a point of instable equilibrium, the jacket rotates, causing the rocker arms at the end of the

ways to rotate as well as the jacket continues to slide from the rocker arms. Forces supporting the jacket on the ways would be evaluated for the full travel of the jacket. Defection of the rocker beam and the effect on loads throughout the jacket would be considered.

In general, the most severe forces will occur at the instant when the rotation starts. Consideration should be given to wind, wave, current and dynamic forces expected on the structure and barge during launching and upending. The consideration is based on American Petroleum Institute Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms – Working Stress Design (API RP 2A-WSD).

Figure1.1. Launch Barge with jacket during transportation.(GustoMSC)

1.2 Problem Statement

Launching analysis of an offshore structure is one of the most important analysis that have to be conducted for installation. The failure could result in damage to local members, defect to transportation barge, overturning of the jacket and barge together, delay the construction period and even total loss of the structure.

The analysis is focusing on the stage to check the possible structural failure or overturning of the barge. It is very important to investigate and optimize the pre-launching conditions prior to separation. The factors that influence launching vary with barge conditions (barge trim angle) and structure specifications (weight of jacket). Besides that, the jacket needs to be considered not to hit the seabed during the launching process and respect to basis allowable requirement stated in code and standard.

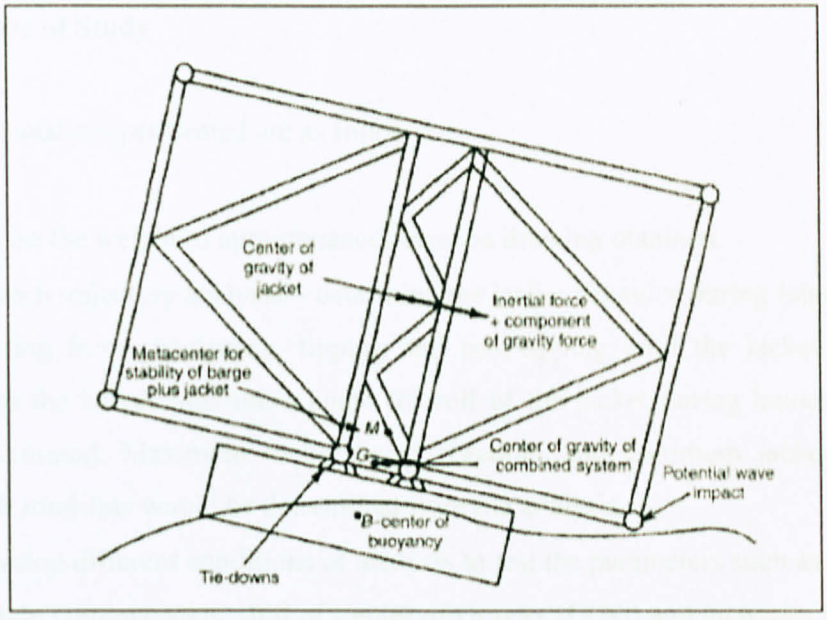


Figure 1.2. Launch Barge with jacket under heavy roll during storm.(Ben C. Gerwick)

Even though the launching itself takes place in a very short time, its success requires a careful design, plan and checklist.

1.3 Objective

The objective of the trajectory launch analysis is to ensure that the jacket structure can be safely launched from a transportation barge and meet the stability and minimum mud-line clearance from sea-bed.

Throughout this project, the objectives to be achieved are:

- To establish optimum jacket launch condition and its liability from analysis result.
- To obtain main parameters and factors that will affect the jacket launch analysis (given different scenarios on the outcome of the analysis).

1.4 Scope of Study

The overall analysis performed are as follows:

- Revise the weight of appurtenances base on drawing obtained.
- Launch trajectory analysis – determine the jacket behavior during launch process starting from pre-tipping, tipping and post-tipping until the jacket separating from the barge. Maximum angle for roll of the jacket during launch are to be determined. Maximum rocker beam reactions and minimum jacket clearance with mud-line would be determined from the analysis.
- Develop different conditions of analysis to test the parameters such as trim angle, weight contingencies, shift of Center of Gravity (COG) and increases in friction.

1.5 Relevancy of Research

This study gives the author some general ideas about jacket launching from a barge motion and the effects to the jacket structure and the barge itself based during unexpected conditions. The vulnerability of the fixed offshore jacket in launch has been determined from this study. Besides that, the behaviour and preferable condition of jacket launch may be used to develop some launching design criteria for future fixed offshore structures.

CHAPTER 2

LITERATURE REVIEW AND THEORY

2.1 Launch

Jackets installation technique is one of the most challenging and risky operations in offshore construction, yet has been successfully performed many hundreds of times. But there are cases of jackets have been damaged or even lost during launching, emphasizing the critical, dynamic nature of this operation.

The worst thing that can happen during a launch is for the jacket to skew sidewise and thus not only tilt the barge to cause the jacket to roll but also cause loads on the jacket frame at the points and in amounts for which it is not designed (Ben C.Geriwick, 1999). Therefore a careful analysis and understanding of the trajectory behaviour during launching is essential to eliminate those failures and to overcome potential loses.

Numerical modeling of launching has been done to check the accuracy of SACS calculation (Nikzad,2008). The results from the same launch analysis carried out by SACS and equations are similar. The output listing generated by SACS governing the operation of launching a jacket form barge, including motion and constraint.

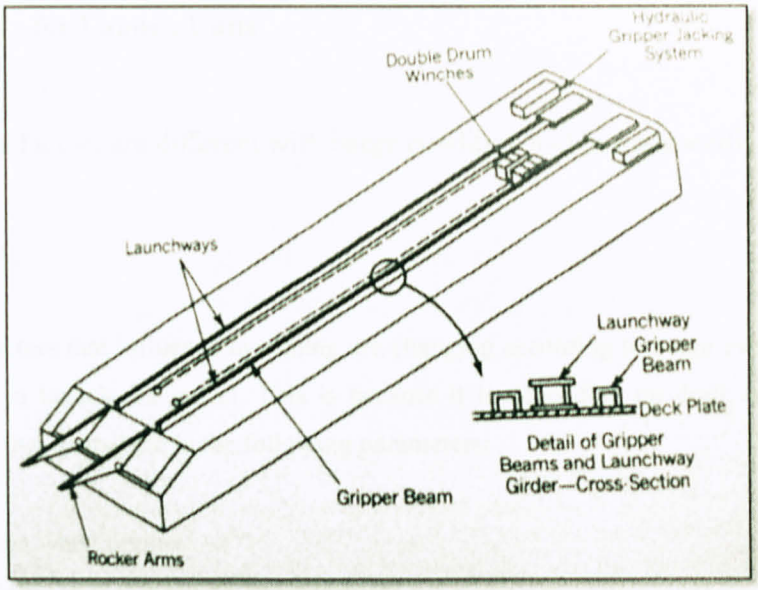


Figure 2.1. Launch Barge. (Ben C Gerwick,1999)

Launching operations are performed over the stern of the launch barge, see Figure 2.1. The launch barge arrives on site with the launch rigging already attached to the jacket and with the jacket overhanging the barge stern. The launch operation starts by trimming the barge typically by about 3-4° by the stern. In order to initiate the sliding of the jacket over the skid beams, the launch winches pull the jacket towards the stern. With larger jackets and barges, the jacket maybe pushed off by hydraulically-operated gripper jacks. As the jacket travels towards the stern the barge trim increases and the sliding process is accelerated till the center of gravity of the jacket passes over the rocker arm hinges. At this point, the jacket starts to rotate with rocker arms to its limit, usually about 30°, and enters the water. The barge accelerates in the opposite direction of the jacket and a complete separation between the two is achieved. This operation normally lasts several minutes.

2.2 Factors for Launch Units

The launching factors are different with barge condition and jacket specifications

2.2.1 Barge

The factors that influence launching are changing according to barge even though same barge is used to launch the jacket. This is because it is depending on draft, trim and rocker beam's length that contribute to the following parameters:

- Reaction when tipping.
- Remaining of jacket length on rocker arm.
- Barge maximum freeboard.
- Mudline clearance.
- Rolling angle during launch.
- Barge ballasting.

Above parameters are taken into account when the analysis being performed.(Lee S.H., 2000)

2.2.2 Jacket

Jacket's tubular member sizes and their properties are not uniform together with the appurtenances; defined as point load is similar for each case. So the influence parameters during launching are as follows:

- Increase and decrease in the jacket selfweight.
- Shifting of center of gravity.
- Percentage of reserved buoyancy
- Properties of launch cradle, friction increase.

The effect of the parameters is investigated by changing condition of launch.(Lee S.H., 2000)

2.3 Launch Trajectory Analysis

The trajectory of the jacket during the launch should be such that the jacket clears the seabed by a sufficient margin. Launch trajectory is predicted by a launch analysis. In the launch analysis, the equations of motion of the barge and the jacket are solved at small discrete intervals during the launch sequence. The jacket entrance into the water introduces drag and inertia loads onto jacket members that resist the jacket motion. The launch trajectory is dictated by relative magnitude of weight and buoyancy of the jacket, the relative positions of their respective centers by damping introduced through the drag loads on the jacket members. Figure 2.2 shows a launched jacket entering the water.

Figure 2.2. Jacket entering the water. (Ultramarine)

The launching analysis was conducted with module named Structural Aanalysis Computer System (SASC) software that can simulate the motion of a structure being launched. The analysis includes a time history description of the jacket and barge motions containing displacement, velocity and acceleration. Although the launch motion is constrained to the vertical plane, hydrodynamic forces are considered in three dimensions with the hydrodynamic characteristics of the barge. The forces on the jacket being encountered during launching can be generated in the study. The motions of jacket and barge can be classified into five launch phases: (Salem & Mourad, 2004)

(a) Phase 1 motion occurs when the structure is sliding on the barge due to the winch with no tipping of the rocker arm.
(b) Phase 2 motion is defined when the structure is sliding on the barge due to gravity or self-weight with no tipping of the rocker arm.
(c) Phase 3 motion occurs when the structure is sliding due to the winch with a tipping of the rocker arm.
(d) Phase 4 motion results from the structure sliding due to self-weight (gravity) with a tipping on the rocker arm.
(e) Phase 5 is the motion that occurs after the structure and the barge are separated.

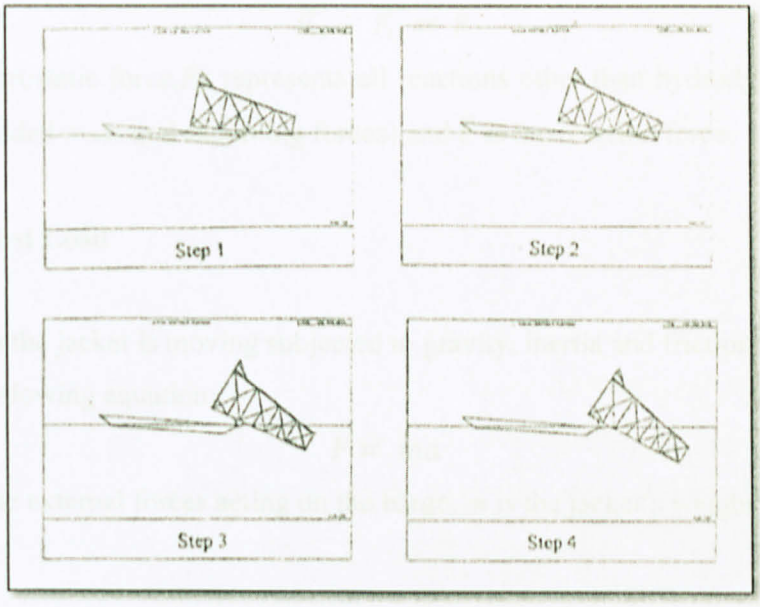


Figure 2.3. Launching Time Steps. (Salem & Mourad, 2004)

2.4 Launching Measurement

In design stage the launch model are taken as it can withstand severe reaction so the jacket will be highly conservative. However the selected case with condition must be reliable with real condition. It is true the client would not expect any loss of the structures. By designing a highly conservative jacket which is not cost effective and heavier; it will affect others processes like load-out and transportation. Also there is no straightforward result could be obtained from SACS analysis. It is depending on guideline stated in API and client design basis.

Not much research about launching has been performed because the process just takes several seconds. Mostly the researches focused on the drag force and inertia calculation. There are equations used to find the drag force, inertia which will be differentiating to define time separation between barge and jacket. The equations are sometimes confusing. Engineering design, however, requires measurement of launch procedure in units such as force, time sliding, mudline clearance from seabed with jacket when launching, rolling angle and reserve buoyancy to make sure the jacket float.

For the body motion, the equation of motion maybe expressed by:

$$\overline{F_H} + \overline{F_O} = \bar{F}$$

Where $F_H$hydrostatic force,F_O represents all reactions other than hydrodynamics forces (buoyancy, added mass and slamming forces) and $\bar{F}$ is the reaction force.

2.4.1 Applied Load

When the jacket is moving subjected to gravity, inertia and friction forces can be express by following equation:

$$F = ma$$

Where F is the external forces acting on the barge, m is the jacket's weight and a is its acceleration.

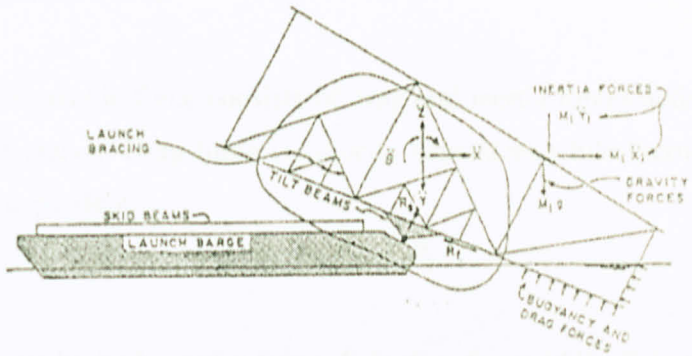


Figure 2.4. Loads on jacket during launching process. (Salem & Mourad, 2004)

From the trajectory of the jacket, the maximum moment occurs when center of gravity of the jacket on the rocker arm which means this jacket is only supported by rocker arm. So jacket inertia forces increase with dynamic motion increases. Moreover the weight acts directly on the rocker arm as it interface between them. Then the reaction being distributed along the rocker arm, this force is composed of acting normal to rocker arm describe as:

$$F = C_F F_N \cos\theta$$

Where

F = Reaction on the rocker arm pin (kN)

C_F = Friction coefficient

F_N = weight of jacket,

θ = trim angle

2.4.2 Wave Forces

Based on the limitations and to avoid unwanted events occur during launching, the operation should take place in calm water. Even though there are waves generated between the areas of installation, the forces have been neglected because the forces are negligible and give insignificant impact to the barge or jacket. However the position of the barge during launching must be parallel with wave motion. In SACS, it is defined that only the motion of an x-y plane occurs with a symmetric characteristic during launching.

2.4.3 Hydrodynamic Force

The hydrodynamic force consists of drag and inertia forces acting on the jacket and barge during launch. Drag force is velocity dependent while inertia forces is time and acceleration dependent.

$$F_H = F_D + F_I$$

Where F_H represents hydrodynamics force, F_D is drag force while F_I is the inertia force. The Morison equation is widely used for the calculation of these forces.

$$F_D = -\frac{1}{2} C_D \rho A_W U|U|$$

$$F_I = C_M \rho V \dot{U}$$

Where C_D is the drag coefficient, ρ is fluid density, A_W is the submerged area, U is the normal velocity component at any points of jacket structure, C_M is inertia coefficient, V is submerge volume and $\dot{U}$ is the normal acceleration at any point of jacket structure.

2.4.4 Slamming Force

The slamming forces would be experienced by the jacket members when the jacket starts to enter the water. These forces have very large magnitudes within a very short interval. However, in reality, the slamming forces may not be large in magnitudes because of the three-dimensional shape of the tubular beams at the upper part of the jacket, so the seawater flows in vortex give lesser impact to the members. Slam force, F_s per unit length can be calculated from the equation taken from API.

$$F_s = C_s \rho D U^2$$

Where C_s is shape coefficient, D is diameter of tubular member and U is the component of water particle velocity normal to the member axis at impact.

2.4.5 Reserve Buoyancy

Most jackets are designed to ride, self-floating, on the upper side legs, with these are about half immersed. This means a freeboard of only half the diameter of a jacket leg. Many of the tubular members, have been subdivided by diaphragm plate to be watertight and empty, in order to provide the needed buoyancy to case the structure to float properly.

The buoyancy force, $F_B$is equal to weight of water being displaced based on following equation:

$$F_B = \rho g V$$

Where ρ is density of seawater, g is gravitational acceleration and V is volume of displaced water by element.

The buoyancy weight must be greater than 15% of jacket's total weight. This buoyancy needed to satisfy the stable condition when the jacket floats and for upending process. It is also use to indicate the minimum clearance between lowest point of jacket to the seabed with respect to trim angle.

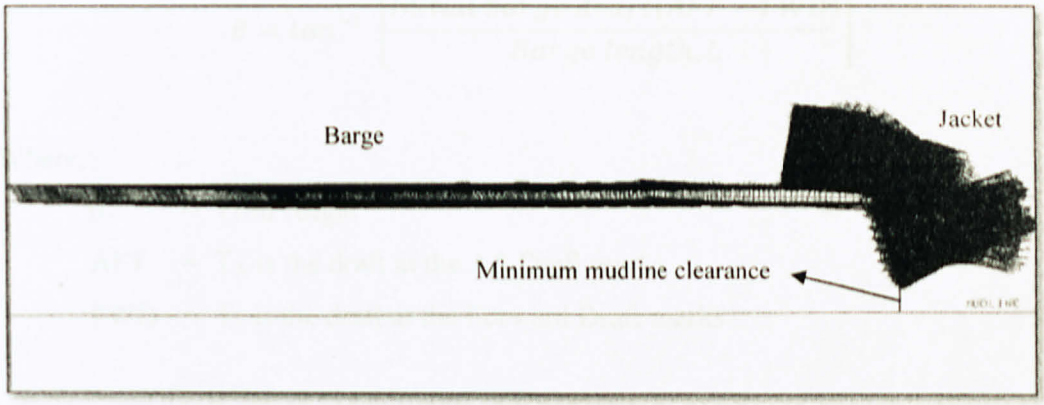


Figure 2.5. Minimum mudline clearance. (SACS)

2.5 Barge Trim

The barge trim angle is controlled by barge ballasting system. This calculation is to know exactly the changes in trim angle value, based on AFT and FWD provided in drawings.

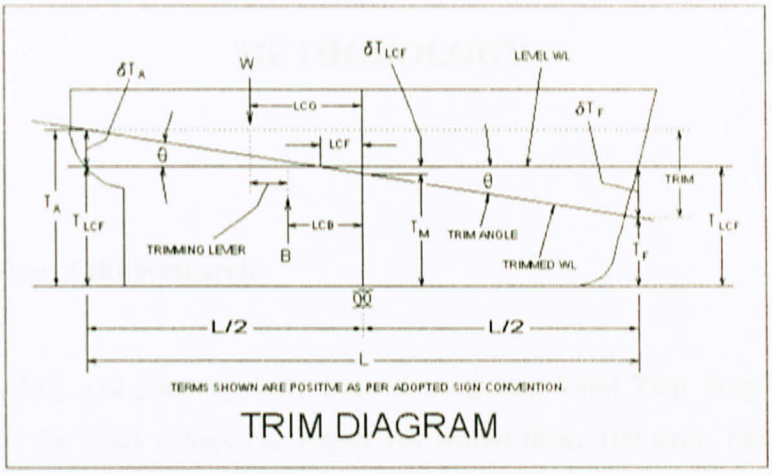


Figure 2.6. Trim Diagram. (Brian, 2004)

The trimming calculation is just variation of this fundamental equation of algebra and geometry:

$$\theta = tan^{-1}\left[\frac{Initial\ barge\ draft(AFT - FWD)}{Barge\ length, L}\right]$$

Where,

θ = Trim Angle

AFT = T_A is the draft at the Aft Draft marks

FWD = T_F is the draft at the Forward Draft marks

CHAPTER 3

METHODOLOGY

3.1 Planning of the Research

Scheduling and planning have been done during Final Year Project 1, January 2009 to ensure the study achieve its objectives within time. The study has been carried out for two semesters and the scope of study is as stated in the previous section.

The information of BCP-A2 offshore jacket is obtained from Aker Engineering Malaysia Sdn. Bhd.. Aker is a leading global oil and gas company which provides engineering and contraction services. This fixed offshore jacket platform located in India is used for the analysis. Trajectory launch analysis has been performed using the standards of American Petroleum Institute.

There are five different stages which have been included in this project. See Figure 3.1 on the flowchart provides a detailed insight into the specific stages as the whole project's methodology.

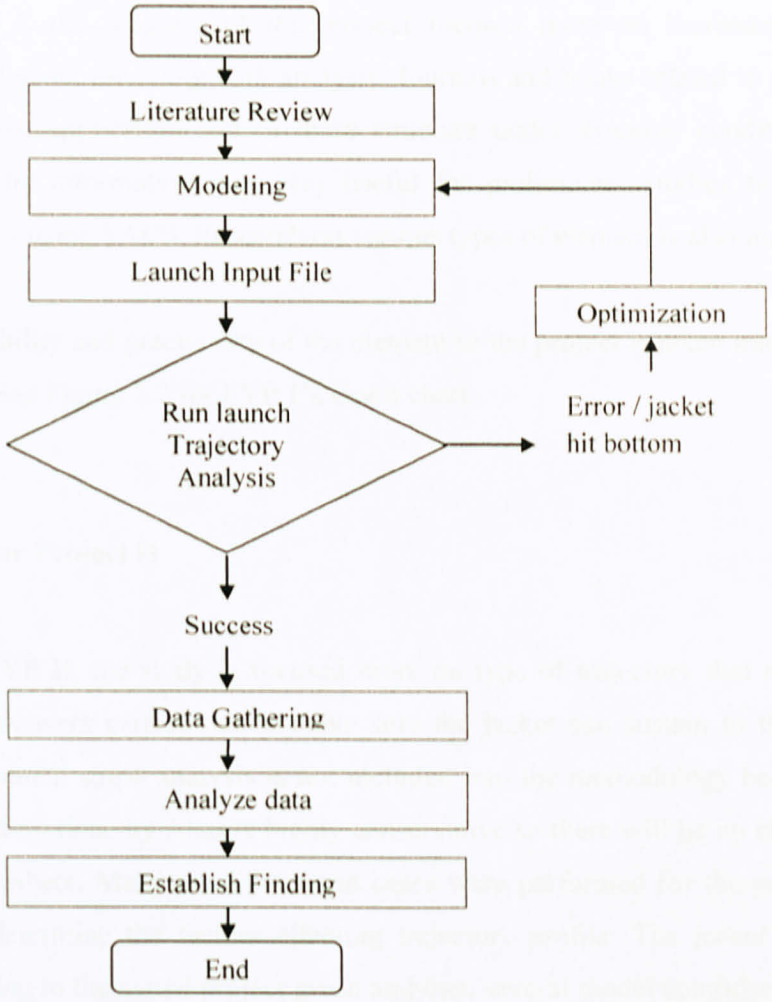


Figure 3.1. Methodology Flowchart

3.1.1 Final Year Project I

For FYP I, the progress of this project focused more on literature review, methodology and some modeling with analysis. Journals and books related to the study of launch analysis, application and offshore structure under dynamic condition have been referred. The information was very useful for preliminary studies to perform launching analysis using SACS. Research on various types of element is also included.

The suitability and practicality of the element to the project is taken into account in this research. See Figure 3.2 for FYP 1's Gantt chart.

3.1.2 Final Year Project II

During FYP II, the study is focused more on type of trajectory that needed to study. Load cases were carried out to make sure the jacket can sustain to the severe condition. The launch stress analysis is not included into the methodology because the nature of calculation done by Aker is highly conservative so there will be no change for overstress in members. Many conditions and cases were performed for the purpose of comparison to determine the factors effecting trajectory profile. The jacket been re-analyzed according to the actual project given and then several model conditions created using structural elements. The results are present in next section. See figure 3.3 for FYP II's Gantt Chart.

ID	Task Name	Duration	Start	Finish
1	**Proposal**	**15 days**	**Mon 1/5/09**	**Fri 1/23/09**
2	**Topics discussion**	**7 days**	**Mon 1/5/09**	**Tue 1/13/09**
3	Internship sv suggestion	2 days	Mon 1/5/0	Tue 1/6/0
4	Preliminary Search	4 days	Wed 1/7/0	Mon 1/12/0
5	Selection of the topic Suggested	1 day	Tue 1/13/0	Tue 1/13/0
6	**Propose topic to sv**	**1 day**	**Mon 1/19/09**	**Mon 1/19/09**
7	Submission of the project title	1 day	Mon 1/19/0	Mon 1/19/0
8	Confirmation of the Topic Propose	4 days	Tue 1/20/0	Fri 1/23/0
9	**Literature Review**	**16 days**	**Mon 1/26/09**	**Mon 2/16/09**
10	**Journal Research**	**15 days**	**Mon 1/26/09**	**Fri 2/13/09**
11	Library Session	1 day	Mon 1/26/0	Mon 1/26/0
12	Journal Search	14 days	Tue 1/27/0	Fri 2/13/0
13	Request Journal from IRC	1 day	Fri 1/30/0	Fri 1/30/0
14	Journal Submission	1 day	Mon 2/16/0	Mon 2/16/0
15	**Structure Model**	**5 days**	**Mon 1/26/09**	**Fri 1/30/09**
16	Selection of Model	1 day	Mon 1/26/0	Mon 1/26/0
17	Request Model Drawing from Aker Soluti	3 days	Tue 1/27/0	Thu 1/29/0
18	Investigate Code And Standards used	1 day	Fri 1/30/0	Fri 1/30/0
19	**Progress Report**	**9 days?**	**Tue 2/17/09**	**Fri 2/27/09**
20	Data and Information Collection	8 days?	Tue 2/17/0	Thu 2/26/0
21	Technical Writing Seminar	1 day	Thu 2/19/0	Thu 2/19/0
22	Submission	1 day	Fri 2/27/0	Fri 2/27/0
23	**Modelling Substructure**	**15 days?**	**Mon 2/2/09**	**Fri 2/20/09**
24	Revise modelling using SACS Software	10 days?	Mon 2/2/0	Fri 2/13/0
25	Calculation of Miscellaneous Loading	5 days	Mon 2/16/0	Fri 2/20/0
26	**1st Phase Analysis**	**30 days?**	**Mon 3/2/09**	**Fri 4/10/09**
27	Study the Analyses Flow Chart	14 days?	Mon 3/2/0	Thu 3/19/0
28	Request Input data Format	1 day	Fri 3/20/0	Fri 3/20/0
29	**Perform Analyses**	**10 days?**	**Mon 3/23/09**	**Fri 4/3/09**
30	Trajectory Analysis	5 days?	Mon 3/23/0	Fri 3/27/0
31	Launch Stress Analysis	5 days	Mon 3/30/0	Fri 4/3/0
32	Analyse Output	5 days	Mon 4/6/0	Fri 4/10/0
33	**Interim report**	**10 days**	**Mon 4/13/09**	**Fri 4/24/09**
34	Collect and prepare report	9 days	Mon 4/13/0	Thu 4/23/0
35	Submission of Interim Report	1 day	Fri 4/24/0	Fri 4/24/0
36	**Investigation**	**5 days**	**Mon 4/27/09**	**Fri 5/1/09**
37	Revise Model and Analyses	5 days	Mon 4/27/0	Fri 5/1/0
38	**Oral Presenatation**	**6 days**	**Mon 4/27/09**	**Mon 5/4/09**
39	Prepare for Oral Pesentation	5 days	Mon 4/27/0	Fri 5/1/0
40	Oral Pesentation	1 day	Mon 5/4/0	Mon 5/4/0

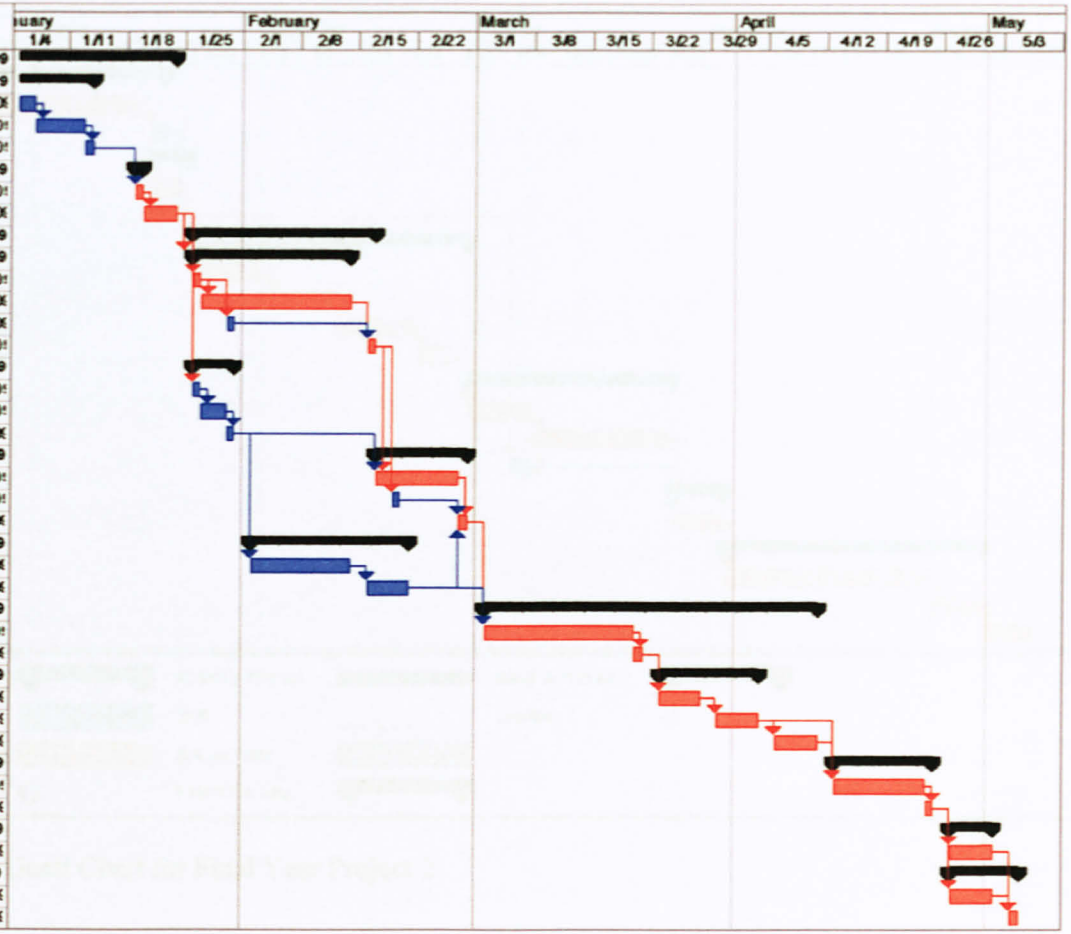


Figure 3.2. Gantt Chart for Final Year Project 1

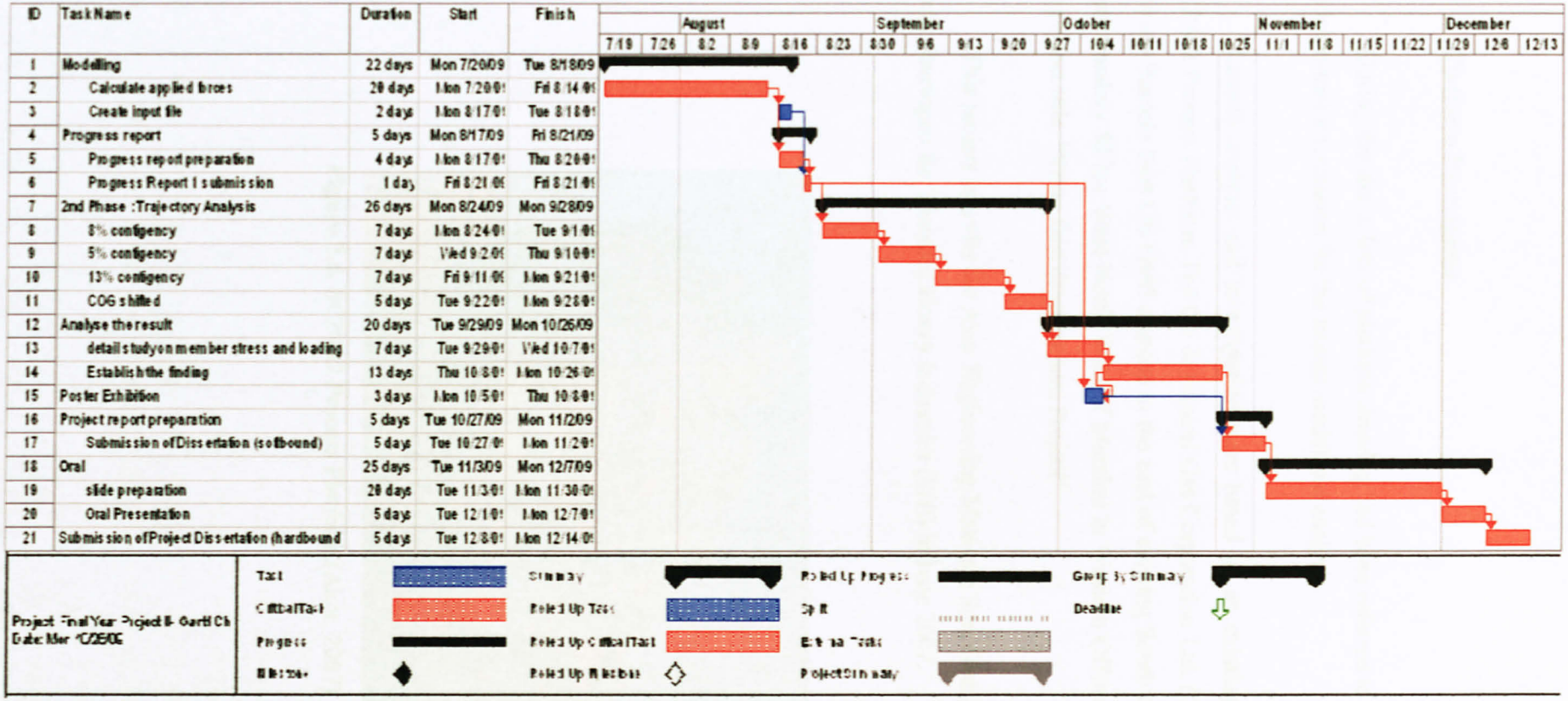


Figure 3.3. Gantt Chart for Final Year Project 2

3.2 Platform Description

During the study, lots of platform drawing had been referred to in order to obtain the important information for the launch model and analysis.

Launch analysis and investigation were based on an existing platform called, BCPA-2 Process Platform. The Oil & Natural Gas Corporation Ltd. (ONGC) intends to develop Bassein East Oil Field situated to the east of existing South Gas Filed, located approximately 80 km West North-West of Mumbai in Western Offshore of India under the project title, "Vasai East development Project".

This project is under the Aker Engineering Malaysia Sdn. Bhd's consultation and it was developed for Samsung Heavy Industries (SHI) in June 2007.

Figure 3.4. BCP-A2 Process Platform.(Aker, 2007)

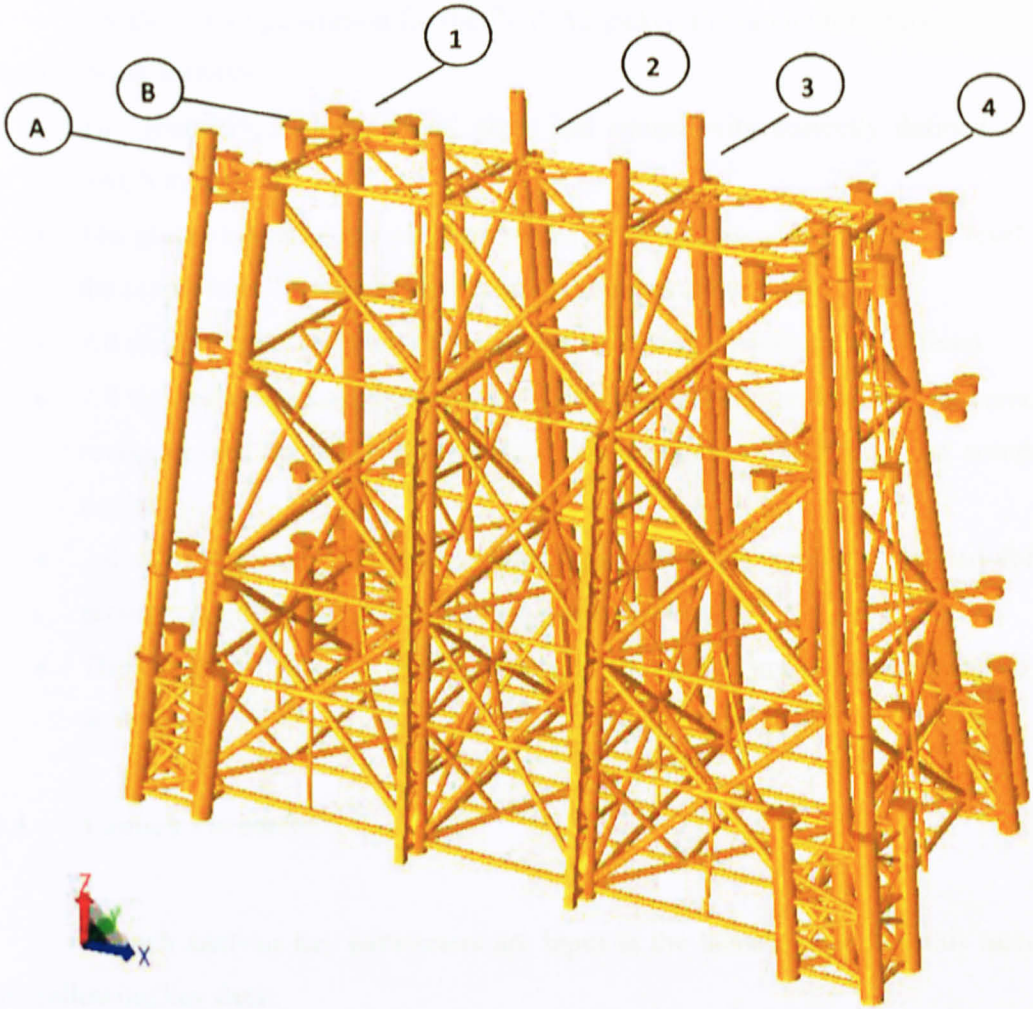


Figure 3.5. Three dimensional view of BCP-A2 Jacket

3.3 Modelling

Structural Analysis Computer System (SACS) is used throughout the whole modeling and analyzing process. Precede Pro is used for interactive modeling and plotting. It is part of a SACS program. Besides that, the parameter and basic load cases have been input through into Data Generator, the input file. It is also used to modify the model when needed. The result of the analysis can be seen on Postvue. Postvue is the output listing file that will generate after analysis completed without error.

For the output generation for the BCP-A2 jacket, the model for analysis contains the following features:

- The geometry, member types, sizes and connectivity correctly defined in the SACS model.
- The global x-axis of the platform model is set as zero at the mean sea level and the model must be translated as it on the transportation barge.
- All the members, sections, group properties and characteristic are defined.
- All the appurtenances, which would affect the distribution loading, are correctly revised based on drawing provided and accurately defined into the computer model.
- All the barge size and hydrodynamic parameter are precisely defined for an accurate output generation due to environmental loads.
- The centers of gravity, friction, weight contingency are defined respect to the analyses.

3.4 Launch Parameters

Launch analysis key parameters are input in the launch input file, this includes the following key data:

- Specified time domain (300 seconds) and interval (1 second) for analysis.
- Jacket orientation and initial jacket position on barge.
- Mud-mat areas are modeled with the drag and added mass coefficients.
- Barge dimension; 120.0m (L) x 33.5m (W) x 7.60m (H)
- Rocker beams dimensions; 15.6m (L) x 2.722m (H)
- Launch barge trim angle prior to launch operation
- Winch speed (0.166m/s).
- Define launch runner joints.
- Launch runners static coefficient of friction (0.15) and dynamic coefficients of friction (0.06).

3.5 Analysis Approach

Jacket launch analysis was performed to confirm the strength of the jacket structure to withstand the various conditions that may be experienced during launching of the jacket. The analysis shall be in accordance with API RP2A WSD, 21st edition. The following describe details procedure taken to perform the trajectory analysis:

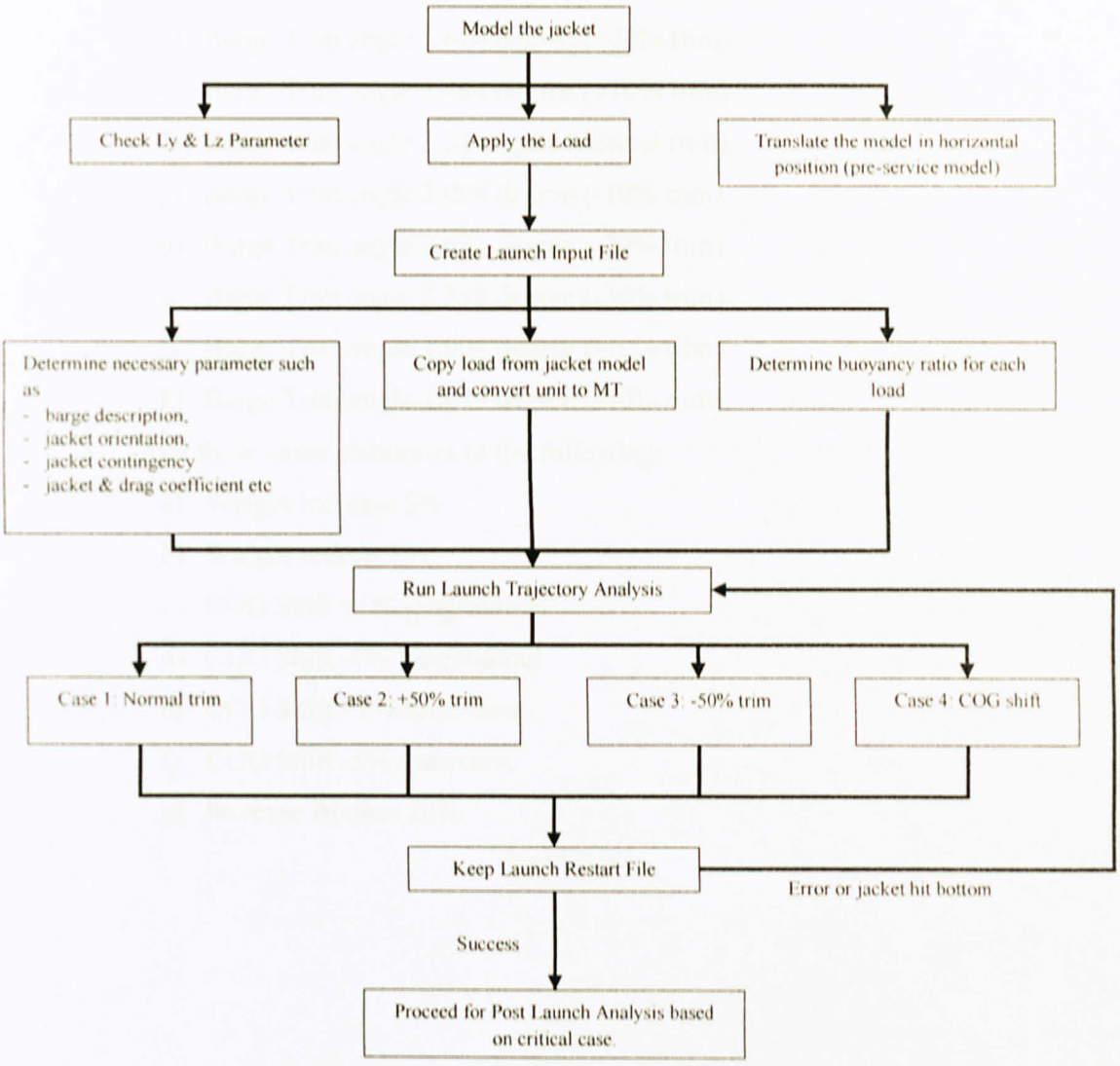


Figure 3.6. Flow Chart for Launch Trajectory Analysis

Cases and conditions are as following:

- Prepare Jacket model based on existing drawings
- Prepare the launch input files based on barge information
- The following scenarios shall be studied:
    a) Barge Trim angle 4.060 degree (+50% trim)
    b) Barge Trim angle 3.916 degree (+40% trim)
    c) Barge Trim angle 3.772 degree (+30% trim)
    d) Barge Trim angle 3.628 degree (+20% trim)
    e) Barge Trim angle 3.484 degree (+10% trim)
    f) Barge Trim angle 3.34 degree (normal trim)
    g) Barge Trim angle 3.006 degree (-10% trim)
    h) Barge Trim angle 2.672 degree (-20% trim)
    i) Barge Trim angle 2.338 degree (-30% trim)
    j) Barge Trim angle 2.004 degree (-40% trim)
    k) Barge Trim angle 1.670 degree (-50% trim)
- From these cases elaborates to the following:
    a) Weight increase 5%
    b) Weight reduce 3%
    c) COG Shift +1% longitudinal
    d) COG Shift -1% longitudinal
    e) COG Shift +1% transverse
    f) COG Shift -1% transverse
    g) Increase friction 20%

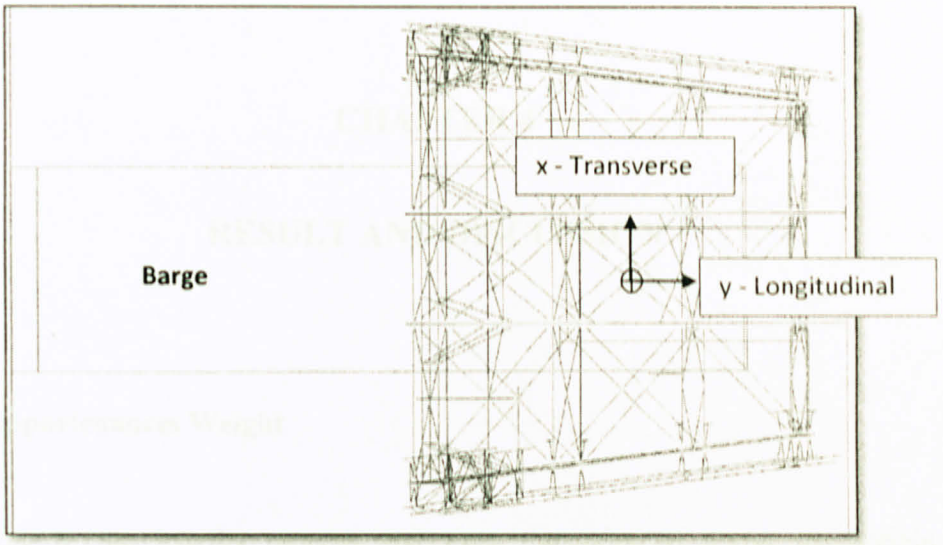


Figure 3.7. Jacket transported position on barge-plan view. (SACS)

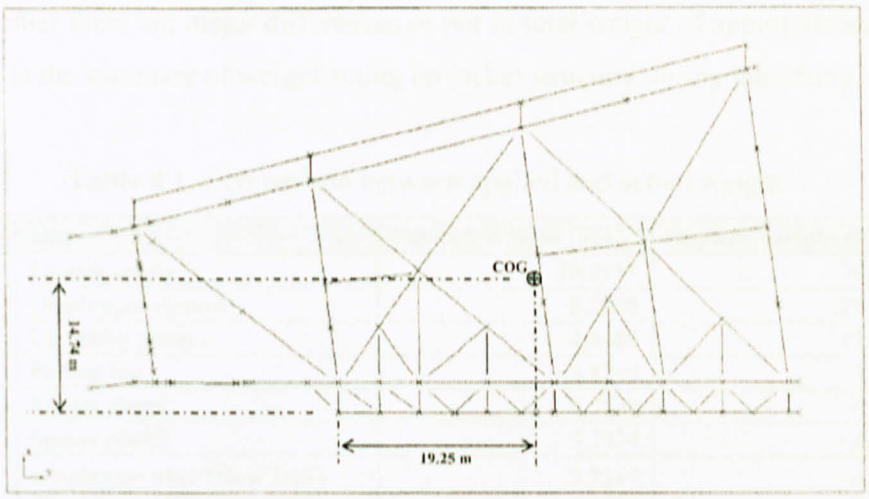


Figure 3.8. COG location during tipping condition. (SACS)

CHAPTER 4

RESULT AND DISCUSSION

4.1 Appurtenances Weight

Due to the lengthy process and time constraint to revise the weight of appurtenances, this weight was calculated once in early stage of project designing. However the load that applies only for items provided by supplier and vendor which is not related to structural design. The weight has been calculated based on latest drawing to see whether there are major differences or not in total weight of appurtenances. Table 4.1 below is the summary of weight acting on jacket structure during launching.

Table 4.1. Comparison between applied and actual weight.

No	Item	Revised Weight (MT)	Applied weight (MT)
1	Launch cradle	70.0111	36.575
2	Diaphragm closure	8.2965	20.440
3	Upending padeye	4.4488	12.452
4	Pulling lug	3.8249	3.090
5	Spacer plate1	0.7539	0.960
	Spacer plate2	3.3924	4.608
6	Diaphragm plate (Row 1&4) Diaphragm plate (Row 2&3)	3.7167 5.2927	4.684 3.344
7	Grout Packer	15.2224	20.292
8	Flooding Line	12.4753	12.420
9	Mutmat	111.8023	170.964
10	Grouting Line (Legs) Grouting Line (Skirt Sleeves)	6.2614 3.7736	3.584 2.160
11	Anodes	348.4142	319.500
12	Handrail	4.5461	10.700
13	Grating	12.3204	6.000
14	Hydrostatic Collapse Ring	5.7189	3.653

15	Joint Ring	19.7438	26.460
16	Welding Bead	5.8614	4.760
17	Bouyancy Tank Ring 1 Bouyancy Tank Ring 2 Bouyancy Tank Ring 3	5.1201 6.6120 13.8900	8.840 6.612 13.890
18	Rigging	35.1840	35.184
	Total	**706.6826**	**731.172**

The weight was applied 3 percent heavier than the actual weight. So there is not much difference. This is also justify the jacket of BCP-A2 is conservatively designed. See Appendix 1 for every appurtenances weight calculation.

4.2 Barge Trim

The draft after (T_A) and forward (T_F) given in drawing for - 50%, +50% and normal barge trim angle only. So to calculate other trim angles, interpolation method is used. See Appendix 2 for barge trim angle drawings.

Table 4.2. Draft FWD and AFT for every barge trim angle

%	Trim Angle (deg.)	FWD (m)	AFT (m)
-50	1.670	2.00	5.040
-40	2.004	1.64	5.290
-30	2.338	1.28	5.540
-20	2.672	0.92	5.790
-10	3.006	0.56	6.040
0	3.340	0.20	6.290
10	3.484	0.20	6.547
20	3.628	0.20	6.810
30	3.772	0.20	7.074
40	3.916	0.20	7.337
50	4.060	0.20	7.600

4.3 Launch Trajectory Cases Detail

Three-dimensional launch trajectory analyses are performed to determine the jacket stability, bottom clearances and barge-jacket behaviour during launching operations. Eleven of barge trim angle were performed for launch trajectory conditions stated in previous section.

The following are 10 cases of trajectory have been selected by considering every 10% increasing and decreasing of trim angle from normal, with variation of parameters in-order to produce the significant graph to be analyzed then:

Table 4.3. Case and condition for every barge trim angle

Case	Condition			
	Weight factor	Center of gravity(cm)		Friction
		Longitudinal	Transverse	
1	1.08	65.0	0.0	0.15
2	1.08	65.0	0.0	0.19
3	1.05	65.0	0.0	0.15
4	1.05	-65.0	0.0	0.15
5	1.05	0.0	75.0	0.15
6	1.05	0.0	-75.0	0.15
7	1.13	65.0	0.0	0.15
8	1.13	-65.0	0.0	0.15
9	1.13	0.0	75.0	0.15
10	1.13	0.0	-75.0	0.15

First case is taken as the base line for this trajectory analysis in the whole components which are rocker pin reaction, minimum mudline clearance, roll angle and reserve buoyancy because it had been analyze and used to be the selected case in pervious design stage. However in this project, the weight of appurtenances has been revised and used in analysis. See Appendix 3 for output listing.

4.4 Static Friction

Table 4.4 and 4.5 are the result for the different friction applied in Case 1 with normal friction and case 2, static friction increased by 20% from normal.

Table 4.4. Results for Case 1 (8% contingency with COG shift and normal friction)

Trim Angle (%)	Maximum Rocker beam Reaction		Minimum Mudline Clearance	Duration from sliding to separations	Barge Roll Angles
	Left	Right			
-50	24063.55	19734.63	12.23	158.58	-0.01
-40	23648.50	19339.55	13.06	133.25	-0.01
-30	23030.88	18720.01	13.69	108.06	-0.01
-20	21854.50	17505.99	13.96	83.47	-0.02
-10	20324.55	15934.69	13.85	59.50	-0.02
0	18565.47	14161.41	13.82	35.46	-0.03
10	18261.25	13843.54	13.60	27.19	-0.03
20	17860.58	13482.70	13.35	23.11	-0.03
30	17443.50	13060.92	13.14	20.65	-0.02
40	16965.51	12597.25	12.82	19.03	-0.02
50	16390.34	12011.17	12.51	17.76	-0.03

Table 4.5. Results for Case 2 (8% contingency with COG shift and increase in friction)

Trim Angle (%)	Maximum Rocker beam Reaction		Minimum Mudline Clearance	Duration from sliding to separations	Barge Roll Angles
	Left	Right			
-50	24063.26	19734.34	12.23	158.58	-0.01
-40	23648.50	19339.55	13.06	133.25	-0.01
-30	23031.00	18720.13	13.69	108.06	-0.01
-20	21853.37	17504.75	13.96	83.47	-0.02
-10	20322.83	15932.86	13.85	59.50	-0.02
0	18556.92	14154.26	13.82	35.46	-0.03
10	18258.97	13841.18	13.60	27.19	-0.03
20	17853.42	13475.69	13.35	23.11	-0.03
30	17439.96	13055.85	13.14	20.65	-0.02
40	16965.51	12597.25	12.82	19.03	-0.02
50	15703.78	11353.68	11.93	18.02	-0.03

Table 4.6. Different between case 1 and 2

Total reaction at rocker arm			Mudline Clearance			Time to separate			Rolling		
0.15	**0.19**	**% different**	**0.15**	**0.19**	**% different**	**0.15**	**0.19**	**% different**	**0.15**	**0.19**	**% different**
43798.18	43797.6	0.001324	12.23	12.23	0	158.58	158.58	0	-0.01	-0.01	0
42988.05	42988.05	0	13.06	13.06	0	133.25	133.25	0	-0.01	-0.01	0
41750.89	41751.13	0.000575	13.69	13.69	0	108.06	108.06	0	-0.01	-0.01	0
39360.49	39358.12	0.006021	13.96	13.96	0	83.47	83.47	0	-0.02	-0.02	0
36259.24	36255.69	0.009791	13.85	13.85	0	59.50	59.50	0	-0.02	-0.02	0
32726.88	32711.18	0.047973	13.82	13.82	0	35.46	35.46	0	-0.03	-0.03	0
32104.79	32100.15	0.014453	13.60	13.60	0	27.19	27.19	0	-0.03	-0.03	0
31343.28	31329.11	0.045209	13.35	13.35	0	23.11	23.11	0	-0.03	-0.03	0
30504.42	30495.81	0.028225	13.14	13.14	0	20.65	20.65	0	-0.02	-0.02	0
29562.76	29562.76	0	12.82	12.82	0	19.03	19.03	0	-0.02	-0.02	0
28401.51	27057.46	4.732319	12.51	11.93	4.636291	17.76	18.02	1.463964	-0.03	-0.03	0
Average % different		0.444172			0.421481			0.133088			0

Note: 0.15 normal friction coefficient, 0.19 friction increase by 20% from normal friction, symbol '%' is percentage

Table above shows that not much different in the reaction, mudline clearance and time separation if the friction coefficient had been increased. This is because of the massive jacket weight gives dominant influence to the launch rather than friction even it increases in value. Moreover grease is used to provide a smooth surface on the skid beam while jacket sliding toward the rocker arm which means no possibility for friction to increase further than 20%. Time separation is quite similar with normal friction and after friction increase because of the winch speed being defined with constants, 0.166m/s.

Therefore for the case 3 to 10, the normal friction is used in the model input file for every condition.

4.5 Center of Gravity (COG)

Shift in COG is taken into account during launch depending on uncertain loads while the structure is exposed to the continuous movement. 1% of longitudinal is 0.65m and 1% of transverse is 0.78 m.

Table 4.7 and 4.8 below are the results for different direction of shifted center of gravity for 5% and 13% of weight factor.

Table 4.7. Results for Case 3-6 (5% weight contingency)

%	Maximum Rocker beam Reaction		Minimum Mudline Clearance	Duration from sliding to separations	Barge Roll Angles
	Left	Right			
Case 3 - 5% Cont, 1% Longitudinal COG Shift, Normal Friction					
-50	23310.97	19102.48	12.72	163.11	-0.01
-40	22899	18700.89	12.61	136.97	-0.01
-30	22244.33	18035.14	12.56	111.16	-0.02
-20	20986.74	16742.07	12.58	85.89	-0.02
-10	19455.85	15190.83	12.52	61.09	-0.03
0	17692.05	13392.68	12.48	36.43	-0.04
10	17350.06	13062.5	12.56	27.89	-0.04
20	17007.92	12734.71	12.62	23.69	-0.04
30	16550.81	12300.36	12.55	21.17	-0.03
40	16107.44	11856.61	12.65	19.51	-0.03
50	15509.28	11268.05	12.61	18.21	-0.03
Case 4 - 5% Cont, (-) 1% Longitudinal COG Shift, Normal Friction					
-50	23483.2	19272.82	13.32	162.67	-0.01
-40	23282.77	19077.89	14.08	136.53	-0.02
-30	22537.17	18345.41	14.45	110.75	-0.02
-20	21494.77	17274.79	14.4	85.43	-0.02
-10	20051.07	15795.94	14.41	60.76	-0.02
0	18328.23	14051.66	14.41	36.14	-0.03
10	18023.83	13748.32	14.49	27.6	-0.03
20	17636.07	13353.25	14.61	23.41	-0.03
30	17164.42	12921.34	14.42	20.9	-0.03
40	16711.78	12458.62	14.09	19.24	-0.03
50	16126.64	11869.72	13.76	17.95	-0.03

Case 5 - 5% Cont, 1% Transverse COG Shift, Normal Friction					
-50	25348.75	17223.64	11.45	162.87	-0.02
-40	24929.22	16869.62	11.43	136.75	-0.03
-30	24334.91	16284.58	11.37	110.93	-0.03
-20	23204.66	15092.63	11.3	85.63	-0.04
-10	21719.46	13523.91	11.28	60.92	-0.06
0	19979.77	11766.99	11.28	36.28	-0.07
10	19724.21	11489.69	11.36	29.02	-0.07
20	19277.85	11079.09	11.3	23.54	-0.08
30	18840.11	10643.71	11.38	21.03	-0.07
40	18362.33	10179.02	11.37	19.37	-0.06
50	17770.43	9604.75	11.43	18.07	-0.07
Case 6 - 5% Cont, (-) 1% Transverse COG Shift, Normal Friction					
-50	21433.73	21136.85	14.15	162.9	0
-40	21070.94	20728.51	14.06	136.76	0
-30	20478.68	20139.12	13.9	110.94	0
-20	19323.71	18977.62	13.91	85.65	0
-10	17797.23	17449.05	13.85	60.94	0
0	16046.93	15702.59	13.8	36.29	0.01
10	15790.45	15449.4	13.83	29.03	0.01
20	15315.96	14981.85	13.96	23.56	0.01
30	14910.54	14584.94	13.88	21.04	0
40	14436.31	14115.64	14	19.38	0.01
50	13841.4	13534.66	13.98	18.08	0.01

Table 4.8. Results for Case 7-10 (13% weight contingency)

%	Maximum Rocker beam Reaction		Minimum Mudline Clearance	Duration from sliding to separations	Barge Roll Angles
	Left	Right			
Case 7 - 13% Cont, 1% Longitudinal, Friction Increase					
-50	24872.2	20353.76	10.13	152.71	-0.01
-40	24463.31	19910.78	9.65	127.26	-0.01
-30	23271.6	18723.06	10.07	104.32	-0.02
-20	21859	17271.29	10.07	80.87	-0.02
-10	20160.67	15555.08	10.05	57.41	-0.02
0	18132.31	13512.52	10.11	34.66	-0.02
10	17874.85	13265.86	10.08	26.81	-0.03
20	17522.78	12937.12	10.09	22.88	-0.02
30	17139.91	12558.45	10.17	20.51	-0.02
40	16642.41	12110.08	10.16	18.94	-0.02
50	16033.06	11511.83	10.18	17.7	-0.03

Case 8 - 13% Cont, - 1% Longitudinal, Friction Increase					
-50	25074.09	20559.33	10.47	152.13	-0.01
-40	24549.08	20037.83	11.31	127.88	-0.01
-30	23723.41	19197.85	11.72	104	-0.01
-20	22400.9	17838.86	11.72	80.52	-0.01
-10	20779.77	16182.8	11.65	57.13	-0.02
0	18901.31	14247.48	11.79	34.39	-0.02
10	18584.8	13990.91	11.63	26.54	-0.02
20	18256.5	13653.33	11.3	22.61	-0.02
30	17864.83	13274.67	11.03	20.24	-0.02
40	17375.16	12797	10.67	18.68	-0.02
50	16804.77	12264.44	10.44	17.45	-0.02
Case 9 - 13% Cont, 1% Transverse, Friction Increase					
-50	27074.75	18355.39	8.63	152.49	-0.02
-40	26509.82	17858.05	8.62	128.06	-0.02
-30	25576.77	16876.82	8.61	104.15	-0.03
-20	24234.19	15450.88	8.55	80.7	-0.04
-10	22590.38	13758.14	8.54	57.27	-0.05
0	20613.88	11754.24	8.57	34.52	-0.05
10	20421.45	11537.37	8.55	27.85	-0.06
20	20025.37	11173.61	8.57	22.73	-0.06
30	19605.98	10780.65	8.62	20.37	-0.05
40	19145.53	10334.39	8.63	18.8	-0.05
50	18538.7	9740.03	8.84	17.57	-0.06
Case 10 - 13% Cont, - 1% Transverse, Friction Increase					
-50	22873.41	22557.08	12.57	152.54	0
-40	22365.15	22000.19	12.3	128.07	0
-30	21414.9	21044.35	12.18	104.16	0
-20	20023.52	19649.84	12.17	80.72	0.01
-10	18371.67	17997.37	12.17	57.28	0.01
0	16393.16	16032.5	12.1	34.53	0.01
10	16160.25	15802.4	12.18	27.87	0.01
20	15778.46	15426.83	12.22	22.75	0.01
30	15369.03	15028.33	12.23	20.38	0.01
40	14885	14580.94	12.35	18.82	0.01
50	14283.38	13995.97	12.35	17.58	0.02

The table above is summary of all result taken from 44 output listing for every case.

4.6 Total Reaction on Rocker Arm Beam

As the jacket moves down the launching way, its weight is imposed progressively to the launch cradle installed on the central jacket legs, until finally all the loads transferred to the rocker arm. These loads are transferred back to the launch cradle which in respect to Newton's third law. The definition of Newton's third law says that when a force exerts on another surface, this surface will simultaneously exerts same force in the opposite direction.

Figure 4.1 and 4.2, show the larger trim angle experienced, less reaction on the rocker arm.

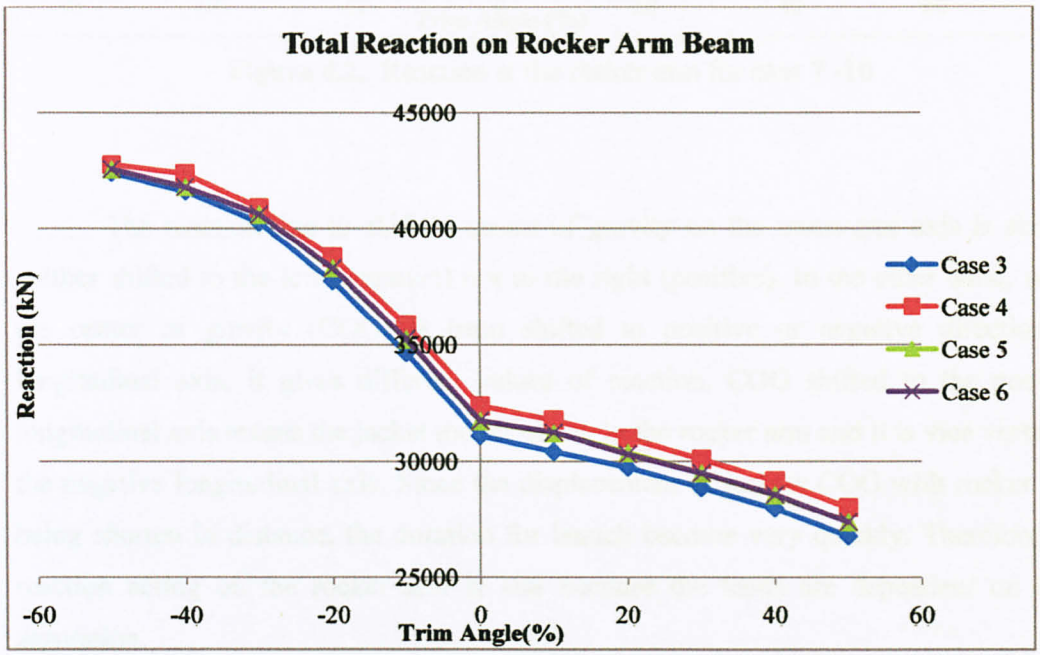


Figure 4.1. Reaction at the rocker arm for case 3 - 6

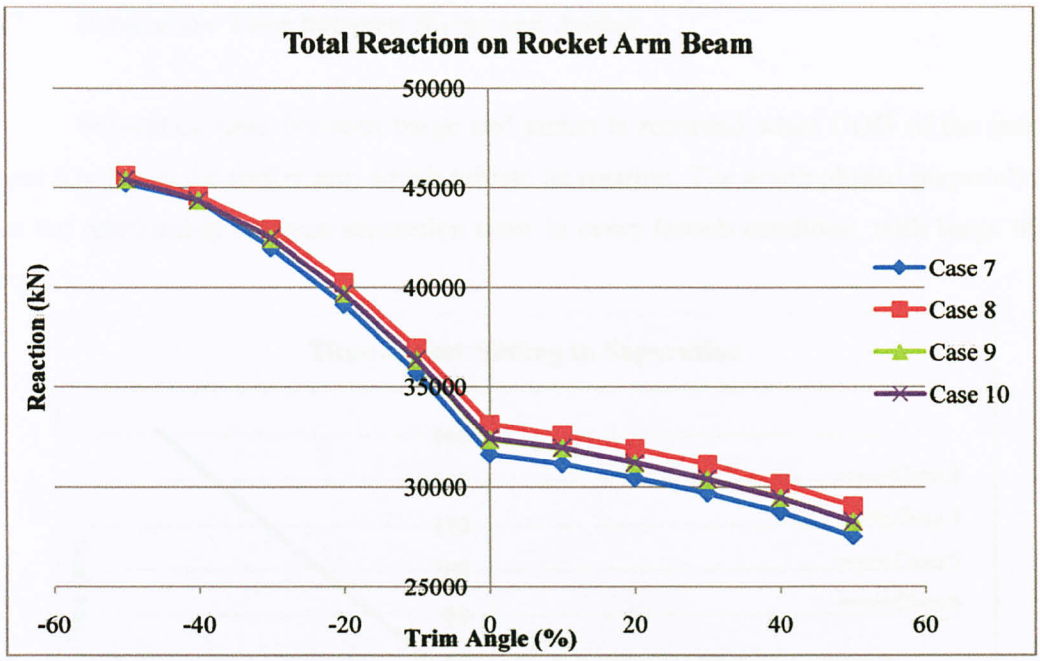


Figure 4.2. Reaction at the rocker arm for case 7 -10

The reaction due to shift in center of gravity on the transverse axis is similar neither shifted to the left (negative) nor to the right (positive). In the other hand, when the center of gravity (COG) is been shifted to positive or negative direction in longitudinal axis; it gives different values of reaction. COG shifted to the positive longitudinal axis means the jacket moves closer to the rocker arm and it is vice versa for the negative longitudinal axis. Since the displacement of jackets COG with rocker arm being shorten in distance, the duration for launch become very quickly. Therefore the reaction acting on the rocker arm is less because the loads are dependent on time separation.

4.7 Separation Time between Barge and Jacket

Separation time between barge and jacket is recorded when COG of the jacket meet a point on the rocker arm which initiate its rotation. The graph plotted purposely to see the relationship between separation time, in every launch condition, with barge trim angle.

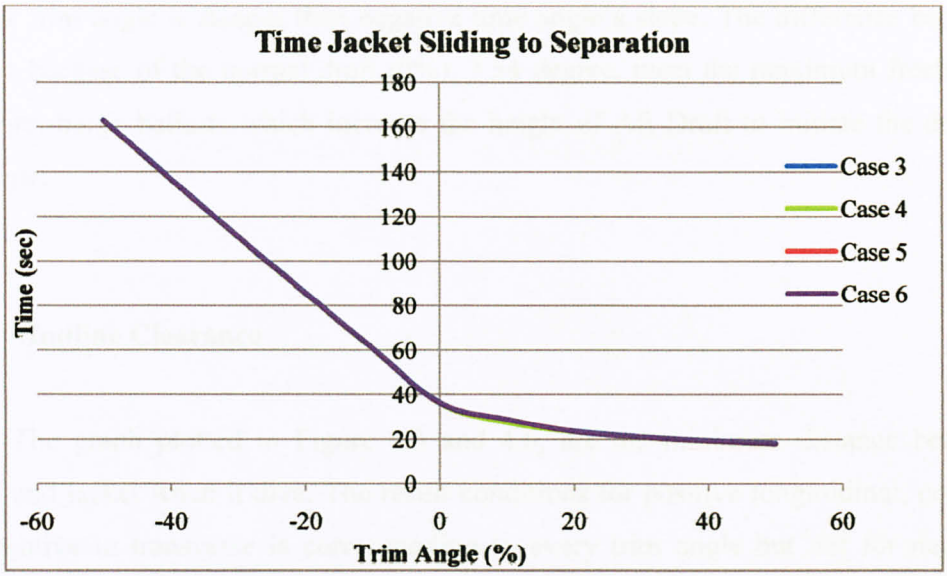


Figure 4.3 Time Separation for case 3 – 6

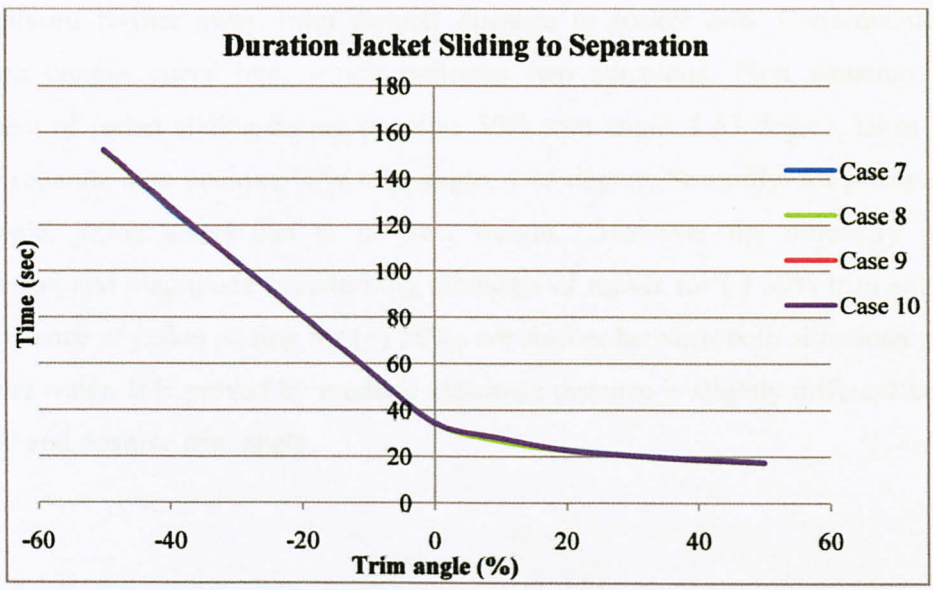


Figure 4.4 Time Separation for case 7 – 10

The time separation is quite similar in every COG shift but still different in value; please see Table 4.7 and 4.8. It is might be depending on the velocity of winch, 0.166m/s, which applies the same value for every COG shift, so it give not much different in time separation.

The time separation is linear to the increasing of barge trim angle. The slope for negative trim angle is steeper than negative time angle's slope. The difference between this two because of the normal draft (0%), 3.34 degree, meet the maximum freeboard. Therefore, barge ballasts which increase the height of Aft Draft to initiate the desired trim angle.

4.8 Mudline Clearance

The graph plotted in Figure 4.5 and 4.6, are the minimum distance between seabed and jacket when it dive. The result conditions for positive longitudinal, positive and negative in transverse is corresponding to every trim angle but not for negative longitudinal COG shifted. As previous explanation, the negative COG shift is where the jacket placed further away from normal distance to rocker arm. Consequently this condition creates curve line, which indicates two situations. First situation is the movement of jacket sliding during negative 50% trim angle, 1.67 degree, takes longer time to separate than positive 50% trim angle, 4.06 degree. Secondly, for positive 50% trim angle, jacket slides due to its own weight. However the trajectory profile, acceleration and magnitude (overturning moments of rocker for (-) 50% trim angle and less resistance of jacket sliding for (+) 50%) are similar between both situations when it enters the water. It is proved by mudline clearance distance is slightly different between negative and positive trim angle.

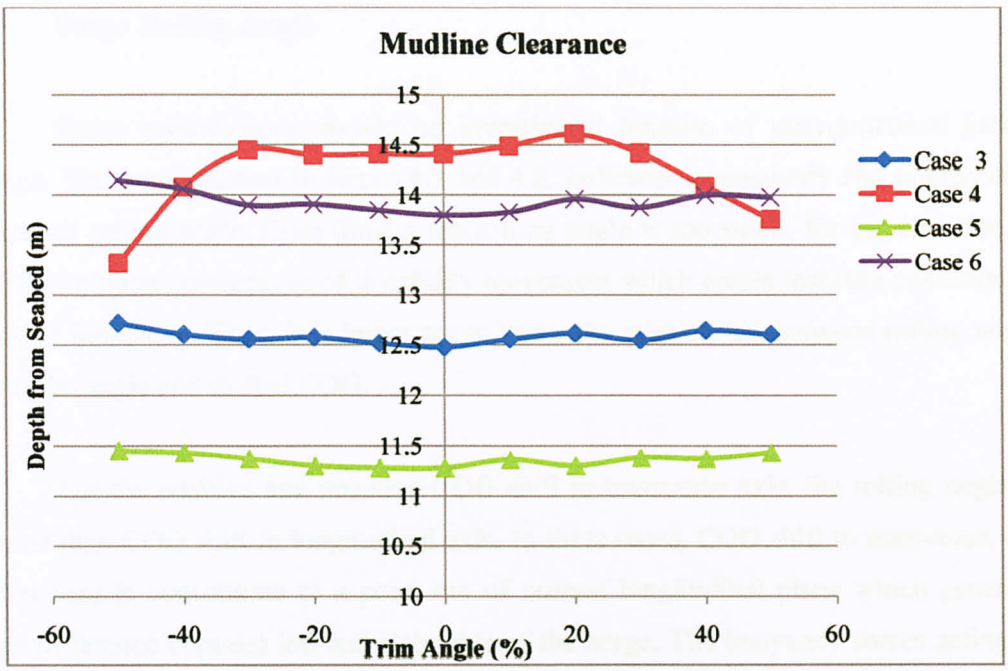


Figure 4.5. Mudline clearance for case 3 - 6

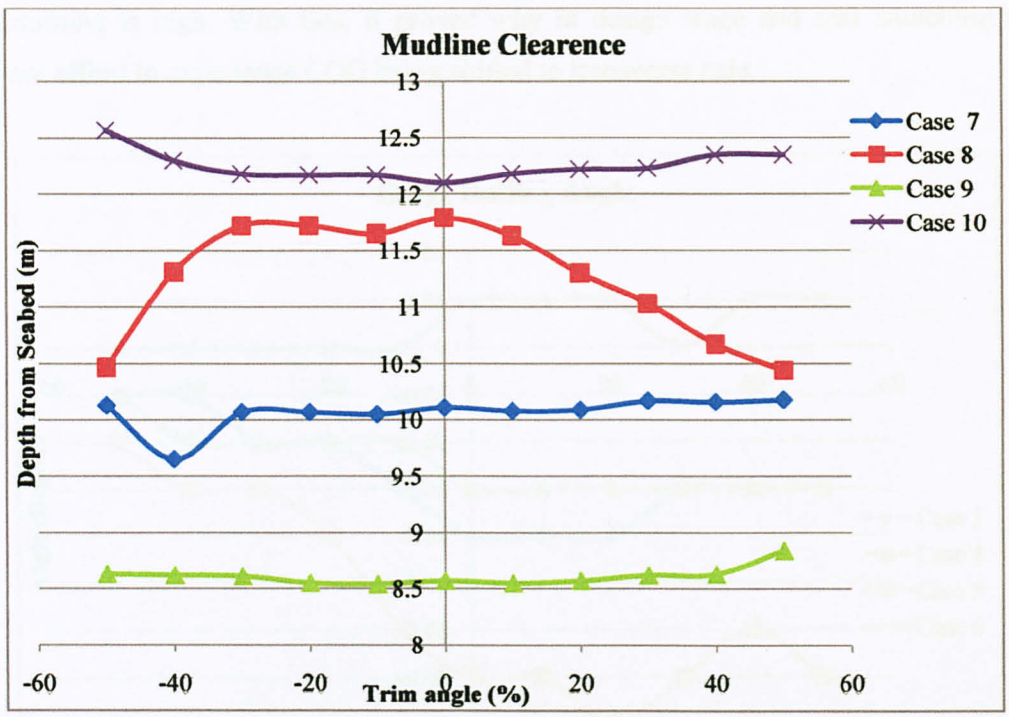


Figure 4.6. Mudline clearance for case 7 – 10

4.9 Barge Rolling Angle

Barge rolling angle should be investigated because of unsymmetrical jacket design. The graph plotted in figure 4.7 and 4.8, indicates inconstantly and unpredicted values of rolling angle. Even though the rolling angle is too small, for big structure, it will feel obvious occurrence of instability movement which create insecure condition to perform launching. Thus, it is important to know the relationship between rolling angle with trim angle and shifted COG.

For the positive and negative COG shift in transverse axis, the rolling angle is greater than COG shift in longitudinal axis. In these cases, COG shift to transverse, the jacket load is concentrate to a point out of normal longitudinal plane which generate huge difference between left and right side of the barge. The buoyancy forces acting to support the barge rolling are same in all direction makes the possibility of barge to overturning is high. With this, it proved why in design stage and real launching we cannot afford to experience COG being shifted to transverse axis.

Figure 4.7. Barge Rolling Angles for case 3 – 6

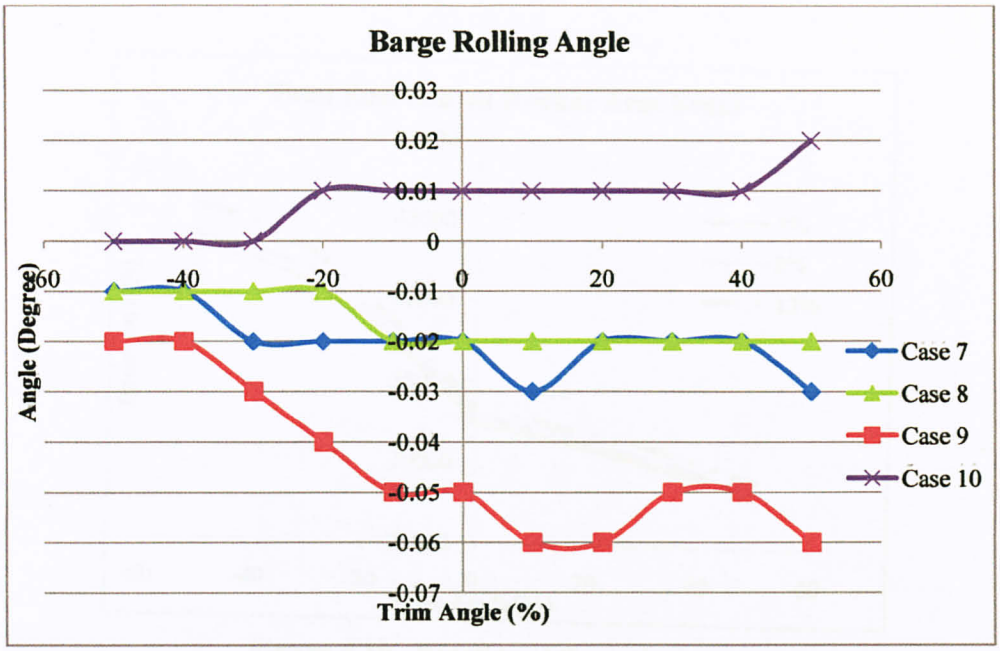


Figure 4.8 Barge Rolling Angles for case 7 - 10

4.10 Comparison between Weight Factors.

The purpose of this comparison between 5%, 8% and 13% weight contingencies is to see the differences in output result of parameters with different jacket weights. The condition of each case is selected by relevancy of output data which discussed in previous sections. Center of gravity being shifted to negative longitudinal indicates most constraint condition and suitable to be considered in designing stage.

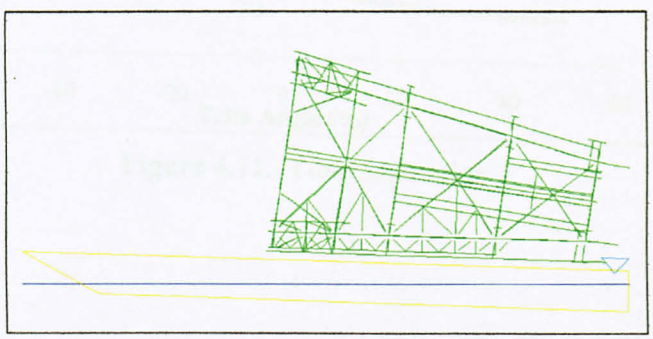


Figure 4.9. Jacket coordination on barge for COG shifted to negative longitudinal.

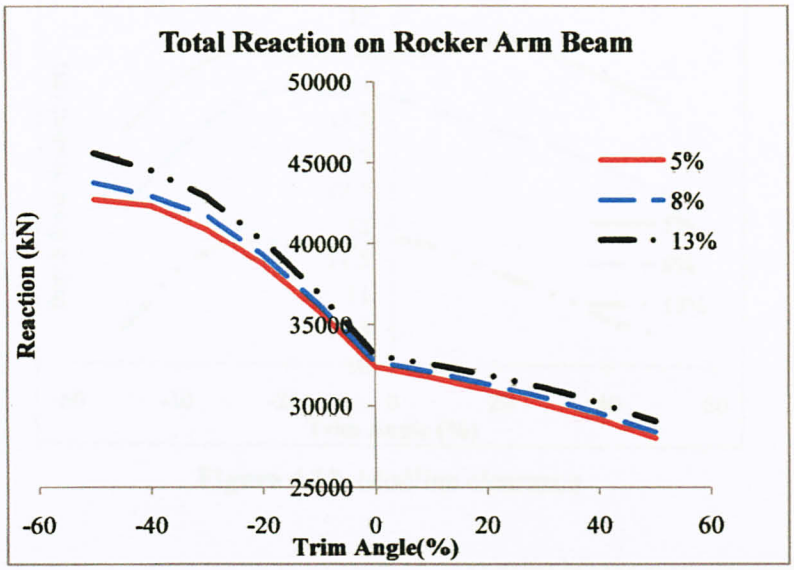


Figure 4.10. Reaction at the rocker arm

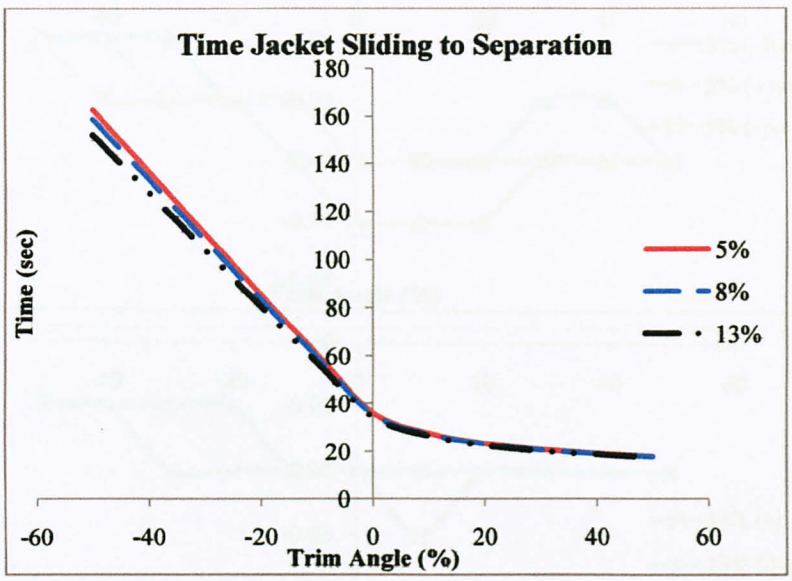


Figure 4.11. Time Separation

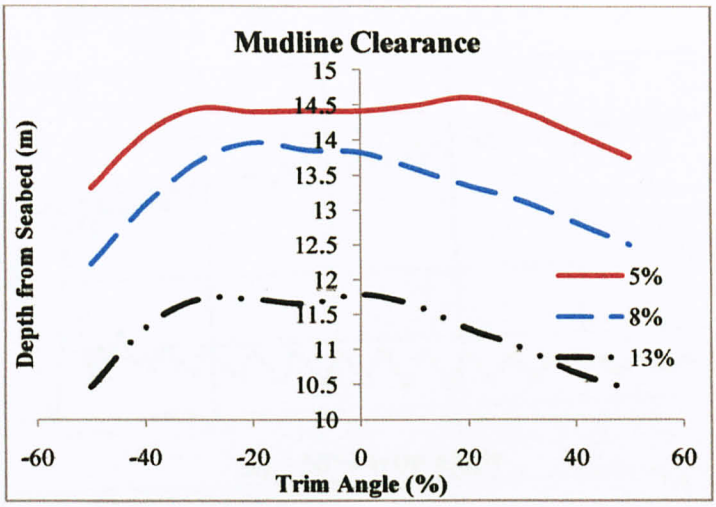


Figure 4.12. Mudline clearance

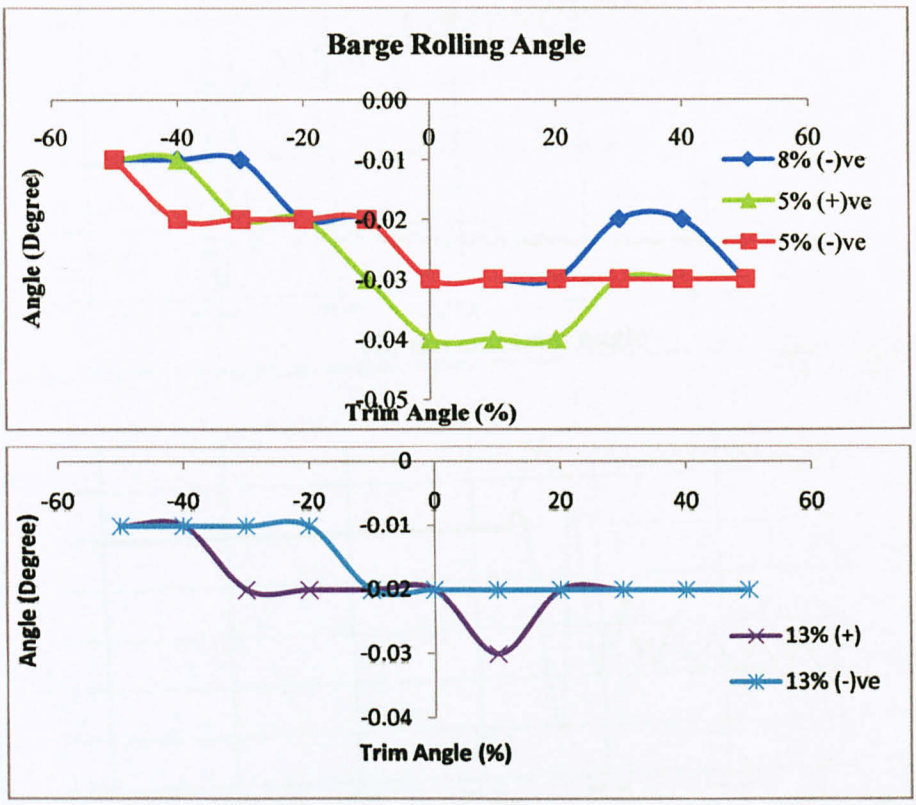
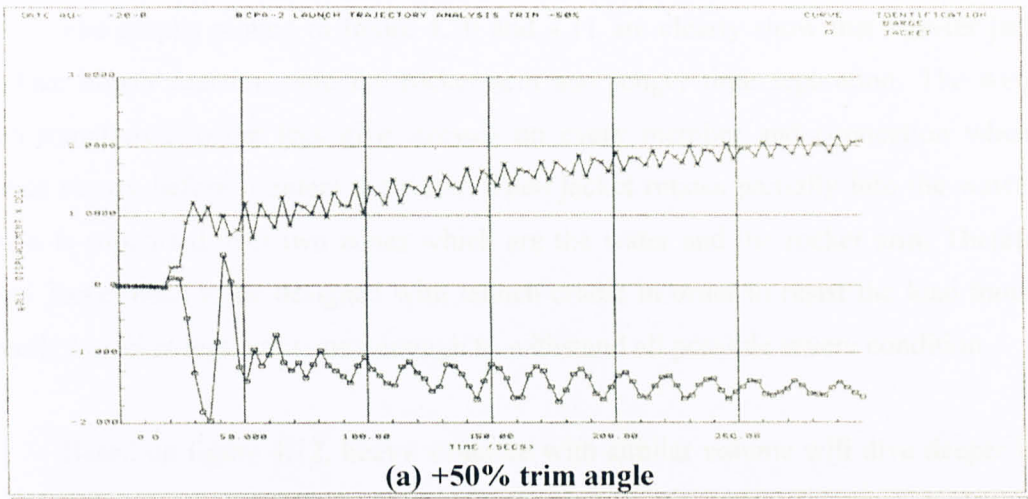
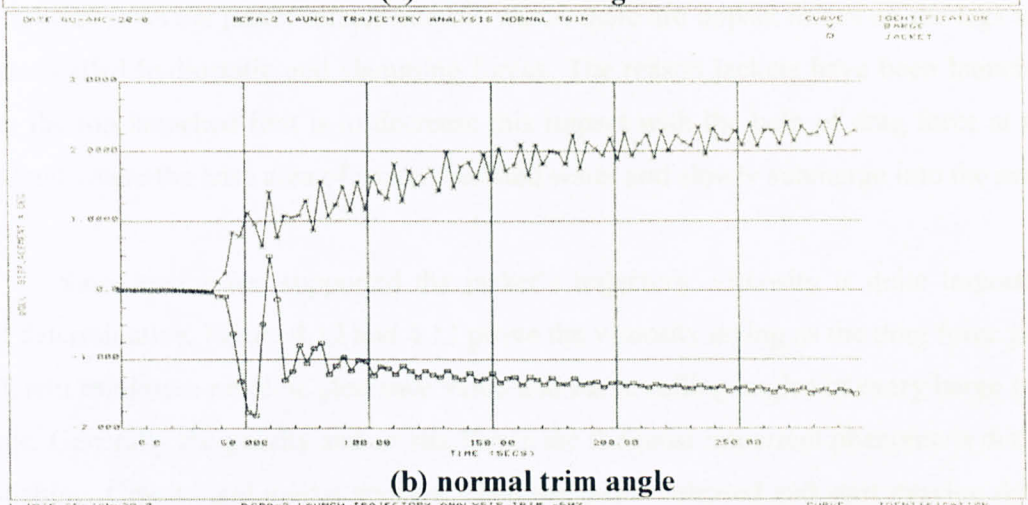


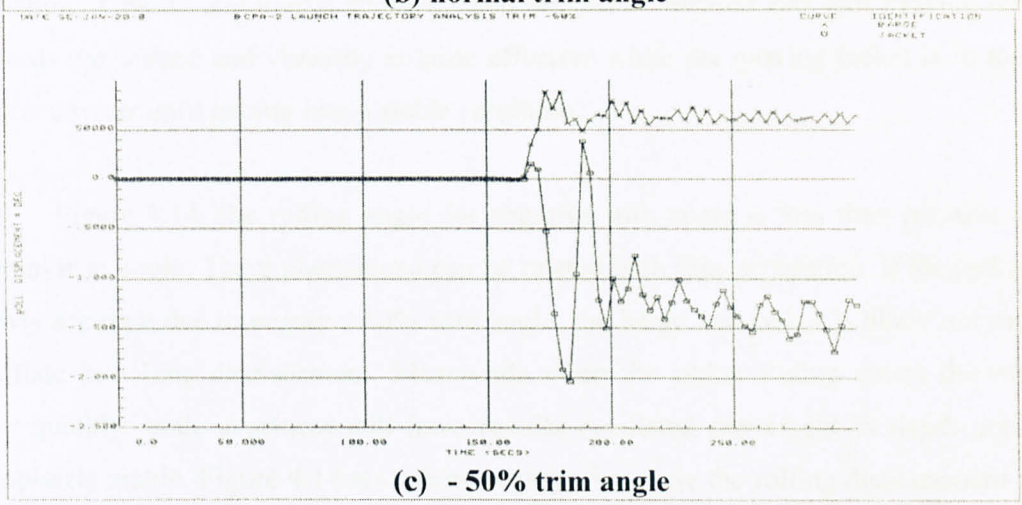
Figure 4.13. Barge Rolling Angles



(a) +50% trim angle



(b) normal trim angle



(c) - 50% trim angle

Figure 4.14 (a)(b)(c). Barge Rolling Displacement w.r.t

The graphs plotted in figure 4.10 and 4.11 are clearly show that heavier jacket produce bigger reaction onto the rocker arm and longer time separation. The weight been transferred to the legs give stresses on every member and connection when it moves slowly before it enters the water. Then jacket rotates partially into the water so that it is supported over two zones which are the water and the rocker arm. Therefore every jacket need to be designed with launch cradle in order to resist the load transfer directly to jacket legs and strong enough to withstand all possible severe condition.

Based on figure 4.12, heavy structure with similar volume will dive deeper into the seawater. As the jacket rotates into the water, there are impact forces on the legs and braces called hydrostatic and slamming forces. The reason jackets have been launched with the top launched first is to decrease this impact with the help of drag force at the mudmat where the base area of jackets resisted water and slowly submerge into the sea.

Since two zones supported the jacket's trajectory, viscosity is quite important and determinative. Figure 4.12 and 4.13 prove the viscosity acting as the drag force give different minimum mudline clearance value and barge rolling angles in every barge trim angle. Generally the gravity and inertia forces are the most important phenomena during launching. Gravity and inertia appears when the jacket released and start moving down towards the seabed and viscosity is quite effective while the moving jacket is in touch with sea water until getting into a stable condition.

Figure 4.14, the rolling angle for negative trim angle is less than positive and normal trim angle. These phenomena can be related with time separation. If the jacket is slowly separate due to negative 50% trim angle, the barge and jacket is likely not much oscillate in rolling displacement. Meanwhile when the jacket sliding enters the water very quickly, both structures will have regular oscillated movement in depth until it completely stable. Figure 4.14 also shows every trim angle the rolling displacement can reach the maximum angle when jacket separate with barge. This rolling displacement will dissipate with respect to time until the structures, barge and jacket, finally in their stable state.

4.11 Reserve buoyancy

Table 4.9. Reserve buoyancy from floatation analysis

Weight Contingency (%)	COG Shift	Reserved Buoyancy (%)
5	(+)1% - Longitudinal	17.92
	(-)1% - Longitudinal	
	(+)1% - Transverse	
	(-) 1% - Transverse	
8	(+)1% - Longitudinal	15.59
	(-)1% - Longitudinal	
	(+)1% - Transverse	
	(-) 1% - Transverse	
13	(+)1% - Longitudinal	11.67
	(-)1% - Longitudinal	
	(+)1% - Transverse	
	(-) 1% - Transverse	

Result for every COG shift in same weight factor is equal for each other. As shown in table 4.9, lighter the jacket weight the tendency to float is high compare to heavier jacket weight. The constraint reaction on the rocker arm is diminishes gradually with as it rotate with jacket. This is because when jacket and rocker arm undergo rotation, the buoyancy of submerged area acts against the jacket weight and illustrate as a support. Therefore the velocity and acceleration change with respect to time as jacket slowly enters the water.

Result in the table above shows the percentage of reserve buoyancy for 13% weight contingency is not satisfied the allowance of requirement of reserve buoyancy.

This is important to provide sufficient mudline clearance for the next installation process, upending. Usually for launching which jacket initially float, upending types is considered by a single hook method with the help of a crane.

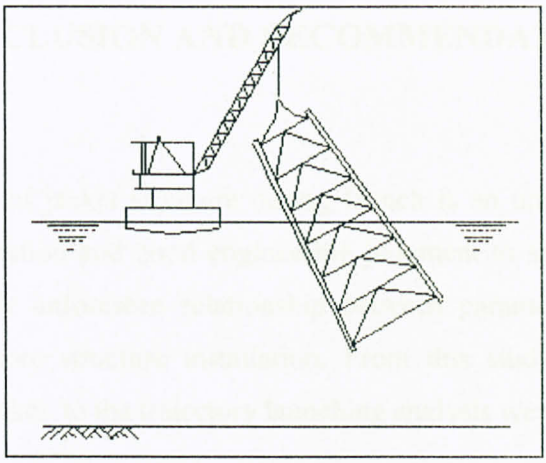


Figure 4.15. Upending with derrick barge. (Ultramarine)

Since the mudline clearance between seabed with the jacket during launch similar for every shift of COG and trim angle, it is not necessarily to provide large reserved buoyancy. See Appendix 4 for output details of floatation analysis.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

The trajectory of jacket structure during launch is an unpredicted process that involves several estimation and good engineering judgment to select the best case for launch analysis. Many unforeseen relationship between parameters still exist in the development of offshore structure installation. From this study, the effect of fixed structures, BCP-A2 jacket, to the trajectory launching analysis were investigated.

During the jacket's movement towards rocker arm beam, the friction is uniform and not much significant changes in separation time and reaction at the rocker arm. The most concern that effects the reaction and separation time is the barge trim angles.

The installation parameters were taken based on the codes and standards used which was determined from studies and investigation from the failure in launching in the past. So the parameters given by design basis and API-WSD have to restrictively follow in every design stage. However the client cannot effort to construct a platform highly conservative. From the study the barge trim angle which is to generate less reaction at the rocker arm beams, shortest time of separation, maximum mudline clearance and high in buoyancy will be chosen as optimum condition. By considering and optimizing the parameters and their effects on the launch operation, including the jackets, the stability of the structure and the safety of the barge could be obtained.

Basically the trajectory profile and condition would not fulfill all the optimum criteria stated before. Based on the study, selection of trajectory condition can be classified into two situations. First, in design stage and second is during actual launch practices. In the first situation, trim angle between negative 50% to normal, 1.67 degree to 3.34 degree, with condition of center of gravity shifted to negative longitudinal axis can be considered as relevant case selection. This is because within the range of negative trim angles and COG shift which is produces more reaction than positive trim angle and generates the lowest mudline clearance respectively. As the motion of the jacket and the barge takes longer time to separate, this case is turned out to be categorized in severe condition and suitable to take as a precaution load in order to design a conservative jacket. Meanwhile in actual launch practices, the barge needs to maintain the normal trim angle with the help of ballast process. The normal trim angle with no shift in COG is the safest condition to perform launch. Thus the objectives for this project have been achieved.

Some recommendations for future mitigation in this project based on the author suggestion by are as follows:

1. The trajectory result generated by SACS can be compared to actual experimental prototype which will give a clear or different perspective and understanding during launching.

2. Second part of the launching analysis which is launching stress analysis, used to check overstress in members, shall be considered and analyzed.

3. Different types of jackets shall be considered in order to obtain clearer view of the behaviours of different weight with different jacket's volume under launching load.

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APPENDICES

APPENDIX 1 : Appurtenances Weight Calculation

Appurtenances: Launch Cradle
Drawing Ref No: BCPA2-DR-SJ-0127-1-2

A Side Plate (Not model in SACS)

Length	=	46490	mm	
Height	=	840	mm	
Plate thickness	=	25	mm	
Quantity	=	2	nos.	
Area	=	39.052	m2	
Volume	=	0.976	m3	
Weight	=	150.37	kN	for each cradle

B Base Plate

Length	=	46490	mm	
Width	=	900	mm	
Plate thickness	=	30	mm	
Quantity	=	0	nos.	Model in SACS
Area	=	41.841	m2	
Volume	=	1.255	m3	
Weight	=	0.00	kN	for each cradle

C Internal Stiffener Plate

Height	=	840	mm	
Width	=	800	mm	
Plate thickness	=	25	mm	
Quantity	=	35	nos.	
Area	=	0.672	m2	
Volume	=	0.017	m3	
Weight	=	45.28	kN	for each cradle

D Closure Plate

Height	=	900	mm	
Width	=	900	mm	
Plate thickness	=	20	mm	
Quantity	=	2	nos.	
Area	=	0.810	m2	
Volume	=	0.016	m3	
Weight	=	2.50	kN	for each cradle

E Clip Plate

Height	=	600	mm
Width	=	200	mm
Plate thickness	=	12	mm
Quantity	=	80	nos.
Area	=	0.120	m2
Volume	=	0.001	m3
Weight	=	8.87	kN for each cradle

F Timber

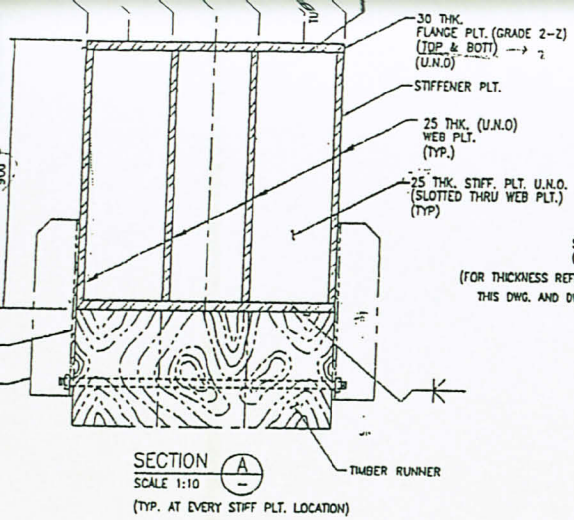
Length	=	46490	mm
Width	=	900	mm
Height	=	400	mm
Quantity	=	1	nos.
Area	=	41.841	m2
Volume	=	16.736	m3
Weight	=	136.27	kN for each cradle

G Total Weight

Total steel weight	=	**207.01**	kN for each cradle
Total timber weight	=	**136.27**	kN for each cradle

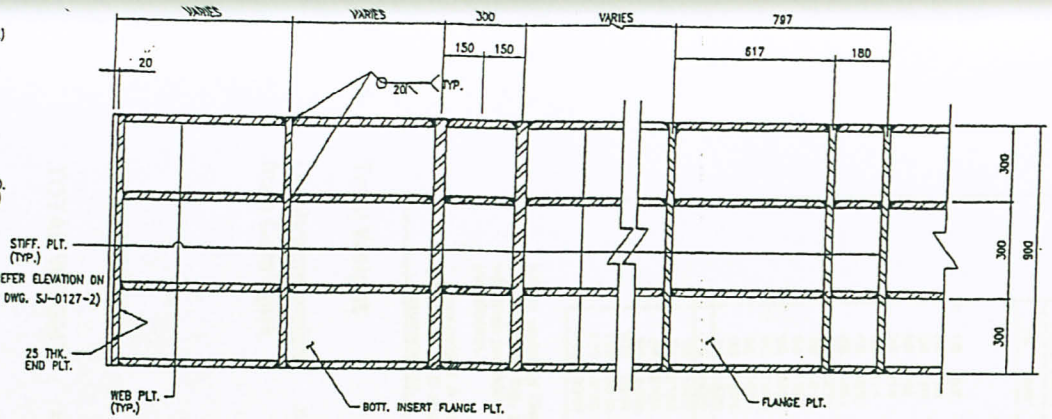
THEREFORE,

TOTAL WEIGHT = 686.57 kN TOTAL AT 2 LOCATIONS

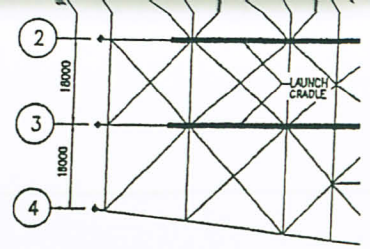


SECTION (A) SCALE 1:10

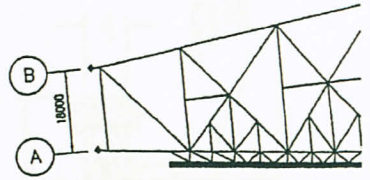
(TYP. AT EVERY STIFF PLT. LOCATION)



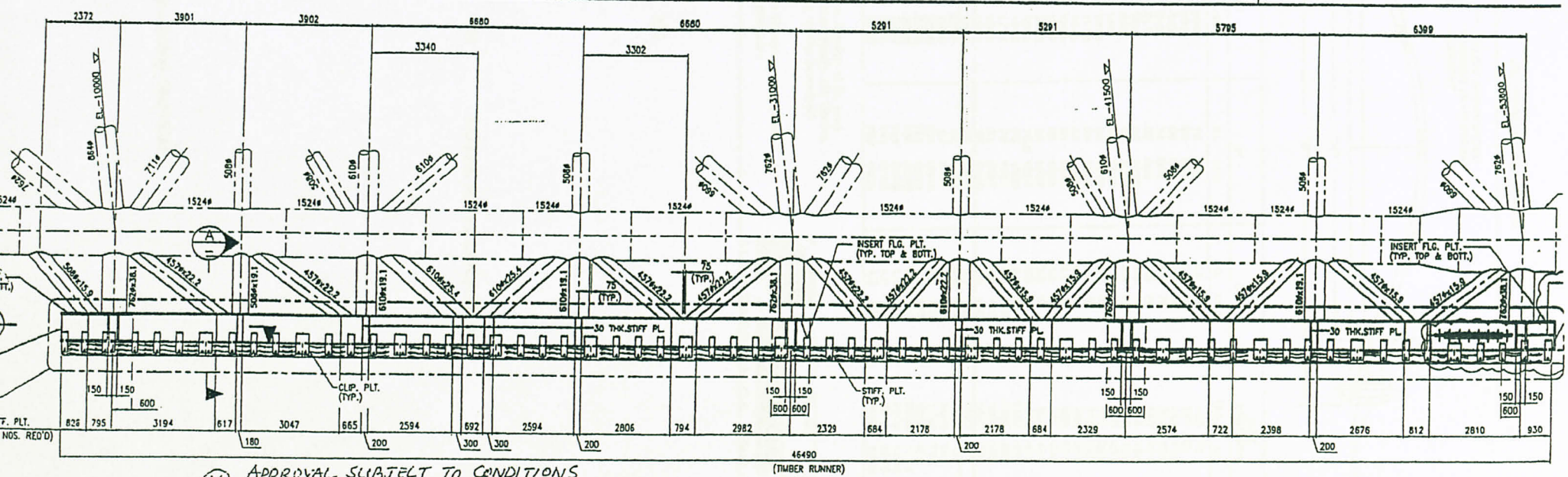
SECTION (B) SCALE 1:10



PLAN AT ROW 'A'



ELEVATION AT ROW '2' AND '3'



(*) APPROVAL SUBJECT TO CONDITIONS MENTIONED IN LETTER NO: MR/OW/VEDP/EIL/OWC-5256 DTD. 13-2-07

LAUNCH CRADLE ELEVATION AT ROW '2' & ROW '3'

SCALE 1:65

0319

AND MATERIAL NOTES, SEE DRAWING NO. BCPA2-DR-SJ-0002.
S & DIMENSIONS ARE IN MILLIMETER.
S ON THIS DRAWING SHALL BE GRADE 2-B U.N.O.
AL SPECIFICATION SHALL CONFORM TO BID SPEC NO. 634/-40-16-SP-04 (REV. 0)

APPROVED REV. NO.

2	12.02.07	APPROVED FOR CONSTRUCTION	RF				
1	12.01.07	APPROVED FOR CONSTRUCTION	AM	SSJ	RAH	MT	BCPA2-DR-SJ-0121-3	LAUNCH CRADLE DETAILS - SHEET 3
0	13.12.06	ISSUED FOR APPROVAL/APPROVED FOR	AM				

SCALE : AS-SHOWN
DRAWN : ZDM
DATE : 20.06.06
CHKD : NA
DATE : NA
APPROVED : NA
DATE : NA
OWNER'S CONSULTANT
LEAD CONTRACTOR

OWNER: ONGC

OIL AND NATURAL GAS CORPOR LIMITED, INDIA

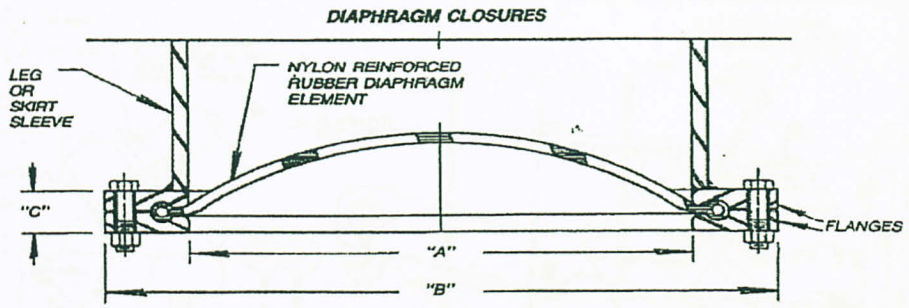
TITLE

BCPA-2 JACKET

LAUNCH CRADLE DETAILS - SHEE

VASHISHT DEVELOPMENT PROJECT BCPA-2 2006

Appurtenances: Diaphragm
Ref: Catalogue



PILE SIZE		A*		B*		C†		EST. WEIGHT‡	
in.	mm	in.	mm	in.	mm	in.	mm	lbs.	kg
		12	305	19	483	2.5	64	165	75
		15	381	22	559	2.5	64	197	89
		19	483	26	660	2.5	64	240	109
18	457	24	610	34	864	3.0	76	304	138
24	610	28	711	38	965	3.0	76	390	177
24	610	30	762	40	1016	3.0	76	414	188
30	762	33	838	43	1092	3.0	76	439	199
36	914	38	965	48	1219	3.0	76	509	231
36	914	40	1016	50	1270	3.5	89	652	296
42	1067	44	1118	54	1372	3.5	89	712	323
42	1067	49	1245	59	1499	3.5	89	796	361
48	1219	51	1295	61	1549	3.5	89	828	376
48	1219	55	1397	65	1651	3.5	89	896	406
54	1372	58	1473	68	1727	3.5	89	951	431
60	1524	63.5	1613	73.5	1867	3.5	89	1062	482
60	1524	66	1676	76	1930	3.5	89	1101	499
66	1676	68	1727	78	1981	4.0	102	1285	583
66	1676	71	1803	81	2057	4.0	102	1366	620
72	1829	75	1905	85	2159	4.0	102	1456	660
72	1829	78	1981	88	2235	4.0	102	1523	691
78	1981	82	2083	92	2337	4.0	102	1602	727
84	2134	87	2210	97	2464	4.0	102	1686	765
84	2134	90	2286	100	2540	4.0	102	1742	790
96	2438	101	2565	111	2819	4.0	102	1966	892
102	2591	107	2718	120	3048	4.0	102	2690	1211
120	3048	128	3251	138	3505	4.0	102	2522	1144
132	3353	139	3531	149	3785	4.0	102	2817	1278
144	3658	149	3785	159	4039	4.0	102	3050	1383

When ordering Diaphragm Closures, furnish O.D. and I.D. of jacket leg, pile O.D., and water depth. Oil States will then provide a detailed drawing of the proposed installation.

* Dimensions A and B can vary to fit various leg sizes.
† Dimension C can vary with test pressure requirements.

OIL STATES MCS, INC.

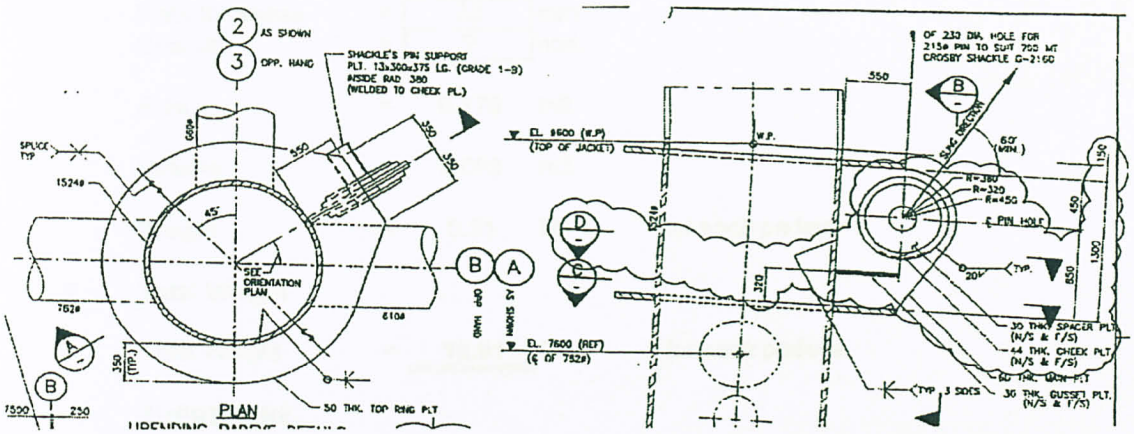
A Total Weight

Diaphragm weight = 6.78 kN
from Catalogue

THEREFORE,

TOTAL WEIGHT = 81.360 kN TOTAL AT 12 LOCATIONS

Appurtenances: Upending Padeye
Drawing Ref No: BCPA2-DR-SJ-0123-0



A Main Plate

Length	=	1300	mm
Width	=	1000	mm
Plate thickness	=	60	mm
Quantity	=	1	nos.
Area	=	1.300	m2
Volume	=	0.078	m3
Weight	=	6.01	kN for each padeye

B Cheek Plate #1

Diameter	=	760	mm
Pinhole	=	230	mm
Plate thickness	=	44	mm
Quantity	=	2	nos.
Area	=	0.412	m2
Volume	=	0.018	m3
Weight	=	2.79	kN for each padeye

C Cheek Plate #2

Diameter	=	640	mm
Pinhole	=	230	mm
Plate thickness	=	30	mm
Quantity	=	2	nos.
Area	=	0.280	m2
Volume	=	0.008	m3
Weight	=	1.29	kN for each padeye

E Gusset Plate

Length	=	550	mm
Width	=	320	mm
Plate thickness	=	30	mm
Quantity	=	2	nos.

Area	=	0.176	m2	
Volume	=	0.005	m3	
Weight	=	0.81	kN	for each padeye

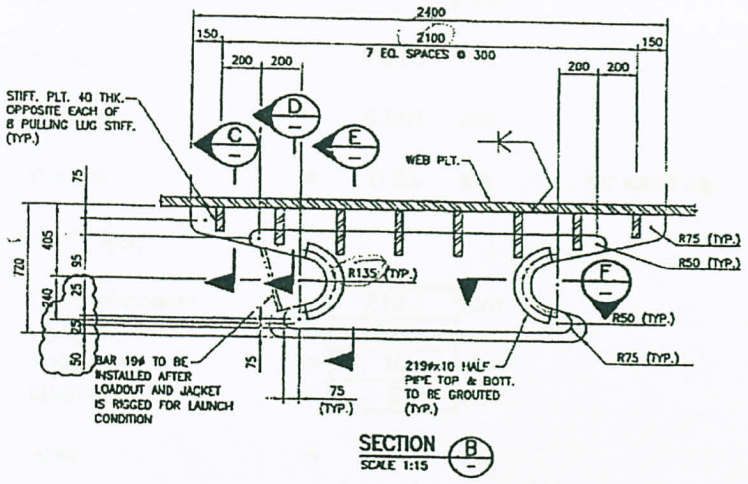
F Total Weight

Total Weight	=	**10.91**	kN	for each padeye

THEREFORE,

TOTAL WEIGHT = 43.63 kN TOTAL AT 4 LOCATIONS

Appurtenances: Pulling Lug
Drawing Ref No: BCPA2-DR-SJ-0127-3-2



A Main Plate

Length	=	2400	mm
Width	=	720	mm
Plate thickness	=	75	mm
Quantity	=	1	nos.
Area	=	1.728	m2
Volume	=	0.130	m3
Weight	=	9.98	kN for each lug

B Cheek Plate

Length	=	1700	mm
Width	=	450	mm
Plate thickness	=	50	mm
Quantity	=	2	nos.
Area	=	0.765	m2
Volume	=	0.038	m3
Weight	=	5.89	kN for each lug

C Stiffener Plate

Height	=	250	mm
Width	=	142	mm
Plate thickness	=	40	mm
Quantity	=	16	nos.
Area	=	0.036	m2
Volume	=	0.001	m3
Weight	=	1.75	kN for each lug

D **Cap Plate**

Outer diameter	=	219.1	mm	
Plate thickness	=	20	mm	
Quantity	=	4	nos.	
Area	=	0.038	m2	
Volume	=	0.001	m3	
Weight	=	0.23	kN	for each lug

E **Half Pipe**

Outer diameter	=	219.1	mm	
Length	=	850	mm	
Thickness	=	10	mm	
Quantity	=	2	nos.	
Area	=	0.585	m2	
Volume	=	0.006	m3	
Weight	=	0.90	kN	for each lug

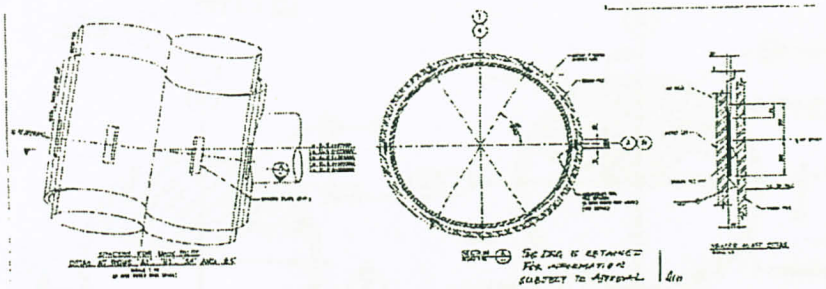
G **Total Weight**

Total Weight	=	**18.75**	kN	for each lug

THEREFORE,

TOTAL WEIGHT	=	**37.51**	**kN**	**TOTAL AT 2 LOCATIONS**

Appurtenances: Spacer Plate
Drawing Ref No: BCPA2-DR-SJ-0122-0

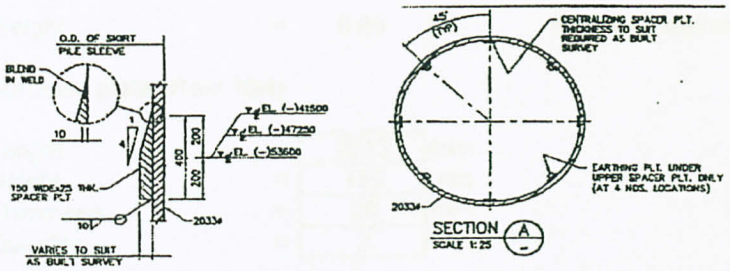


A Plate Size at Main Leg

Height	=	400	mm
Width	=	100	mm
Plate thickness	=	20	mm

B Total Weight

Quantity	=	6	nos.	at each joint
Area	=	0.040	m2	
Volume	=	0.001	m3	
Total weight	=	**0.37**	kN	at each joint 5 joint at each leg



C Plate Size at Skirt Pile Sleeve

Height	=	400	mm
Width	=	150	mm
Plate thickness	=	25	mm

B Total Weight

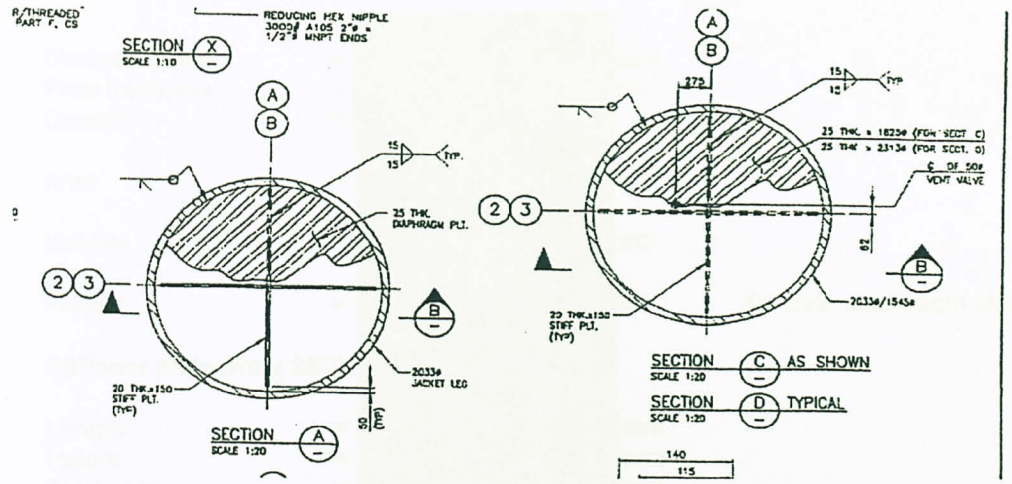
Quantity	=	8	nos.	at each joint
Area	=	0.060	m2	
Volume	=	0.002	m3	
Total weight	=	**0.92**	kN	at each joint 3 joint at each pile sleeve

THEREFORE,

TOTAL WEIGHT	=	7.39	kN	**TOTAL AT 20 LOCATIONS AT MAIN LEGS**
	=	33.27	kN	**TOTAL AT 36 LOCATIONS AT SKIRT PILE SLEEVES**
	=	40.66	kN	

Appurtenances: Diaphragm plate

Ref: BCPA2-DR-SJ-0124-0



A Ring plate (Row 1&4)

Diameter plate	=	2313	mm
Plate thickness	=	25	mm
Quantity	=	1	
Area	=	4.202	m2
Volume	=	0.105	m3
Weight	=	8.09	kN for each diaphragm plate

B Stiffener plate (Row 1&4)

Length	=	2213	mm
Height	=	150	mm
Thickness	=	20	mm
Quantity	=	2	
Area	=	0.332	m2
Volume	=	0.007	m3
Weight	=	1.02	kN for each diaphragm plate

C TOTAL WEIGHT (Row 1&4)

Total weight	=	9.11	kN
TOTAL WEIGHT	=	**36.448**	**kN** **TOTAL AT 4 LOCATIONS**

A Ring plate (Row 2&3)

		TOP	BOTTOM		
Diameter plate	=	1825	2048	mm	
Plate thickness	=	25	25	mm	
Quantity	=	1	1		
Area	=	2.616	3.246	m2	
Volume	=	0.065	0.081	m3	
Weight	=	5.04	6.25	kN	for each diaphragm plate

B Stiffener plate (Row 2&3)

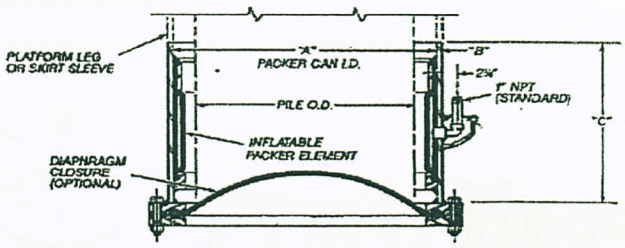
Length	=	1725	1923	mm	
Height	=	150	150	mm	
Thickness	=	20	20	mm	
Quantity	=	2	2		
Area	=	0.259	0.288	m2	
Volume	=	0.005	0.006	m3	
Weight	=	0.80	0.89	kN	for each diaphragm plate

C TOTAL WEIGHT (Row 2&3)

Total weight	=	12.98	kN	
TOTAL WEIGHT	=	**51.903**	**kN**	**TOTAL AT 4 LOCATIONS**

Appurtenances: Grout Packer
Ref: Catalogue

INFLATABLE GROUTING PACKERS



PILE SIZE		A		B*		C		GUIDE SHIM MAXIMUM I.D.		PACKER ASS'Y. EST. WEIGHT†	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	lbs.	kg
16	406	21	533	.75	19	24	610	17	432	498	226
18	457	23	584	.75	19	24	610	19	483	544	247
22	559	27	686	.75	19	24	610	23	584	637	289
24	610	30	762	.75	19	24	610	26	660	707	321
30	762	35	889	.75	19	24	610	31	787	825	374
30	762	36	914	.75	19	24	610	32	813	849	385
36	914	41	1041	.75	19	24	610	37	940	956	438
38	965	44	1118	.75	19	24	610	40	1016	1036	470
40	1016	45	1143	.75	19	24	610	41	1041	1060	481
42	1067	46	1168	.75	19	24	610	43	1092	980	445
42	1067	47	1194	.75	19	24	610	43	1092	1106	502
42	1067	48	1219	.75	19	24	610	44	1118	1071	486
44	1118	49	1245	.75	19	24	610	45	1143	1153	523
44	1118	50	1270	.75	19	24	610	46	1168	1177	534
46	1168	52	1321	.75	19	24	610	48	1219	1223	555
48	1219	52.5	1334	.75	19	24	610	49.5	1257	1180	535
48	1219	54	1372	.75	19	24	610	50	1270	1271	577
53	1346	58.5	1486	.75	19	24	610	54.5	1384	1376	624
54	1372	58.5	1486	.75	19	24	610	55.5	1410	1314	596
54	1372	59.5	1511	.75	19	24	610	55.5	1410	1400	635
56	1422	62	1575	1.00	25	24	610	58	1473	1797	815
60	1524	66	1676	1.00	25	30	762	62	1575	2339	1061
62	1575	68	1727	1.00	25	24	610	64	1626	1926	874
66	1676	72	1829	1.00	25	30	762	68	1727	2549	1156
66	1676	74	1880	1.00	25	30	762	70	1778	2619	1188
72	1829	78	1981	1.00	25	30	762	74	1880	2761	1252
72	1829	79	2007	1.00	25	30	762	75	1905	2795	1268
74	1880	80	2032	1.00	25	30	762	76	1930	2831	1284
78	1981	84	2134	1.50	38	30	762	80	2032	4146	1881
78	1981	85	2159	1.50	38	30	762	81	2057	4198	1904
84	2134	90	2286	1.50	38	30	762	86	2184	4428	2009
84	2134	91	2311	1.50	38	30	762	87	2210	4477	2031
87	2210	93	2367	1.50	38	36	9'-4	89	2261	5217	2366
96	2438	102	2591	1.50	38	30	762	98	2489	4992	2264
96	2438	104	2642	1.50	38	34	864	100	2540	5724	2596
102	2591	108	2743	1.50	38	30	762	104	2642	5103	2315
104	2642	110	2794	1.50	38	30	762	106.5	2705	4907	2225
104	2642	112	2845	1.50	38	38	9'-4	108	2743	6268	2843
108	2743	114	2896	1.50	38	30	762	110	2794	5383	2442
120	3048	127	3226	1.50	38	30	762	123	3124	6298	2857

When ordering Grouting Packers, furnish O.D. and I.D. of jacket leg, pile O.D., and water depth. Oil States will then provide a detailed drawing of the proposed installation. Some applications may require transition rings.

*Dimension B can vary with test pressure requirements.

†Estimated weight can vary with application and test pressures.

Oil States

5819 Almeda Genoa
Houston, Texas 77048
Ph. 713 991 5621
Fx. 713 991 8500

• Arlington, Texas 76004 • Telephone 817-468-1400 • Fax 817-468-5200
e Green, West Drayton, Middlesex UB7 7PN, England • 441-895-444006 • Fax 441-895-422722

2M 4/96 OSI 624

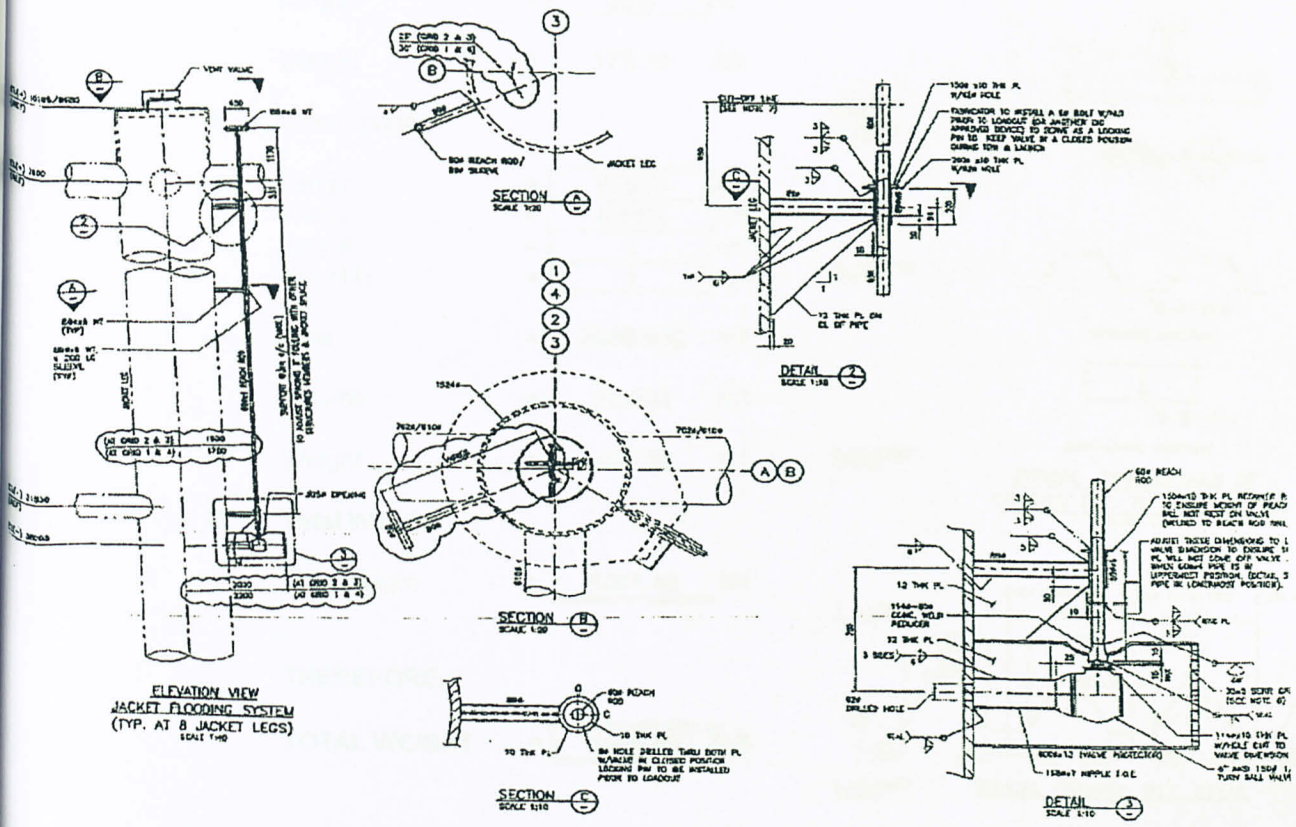
A Total Weight

Grout line weight = 12.44 kN
from Catalogue

THEREFORE,

TOTAL WEIGHT = 149.280 kN TOTAL AT 12 LOCATIONS

Appurtenances: Flooding Line
Ref : *BCPA2 Jacket Model (Fabricator)*



A Total Weight

Flood line weight = 122.34 kN
from BCPA-2

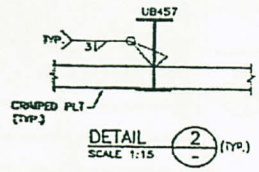
THEREFORE,

TOTAL WEIGHT = 122.340 kN TOTAL AT 32 LOCATIONS

Appurtenances: Mudmat
Drawing Ref No: BCPA2-DR-SJ-0119-0

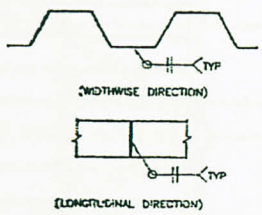
A Stringer

I-beam section	=	457x191x82	
Unit weight	=	17.8	kg/m
Length	=	30.8	m
Weight	=	172.10	kN



B Crimp plate

Length	=	69800	mm
Width	=	42989	mm
Height	=	4	mm
Quantity	=	1	nos.
Area	=	3000.632	m2
Volume	=	12.003	m3
Weight	=	924.30	kN



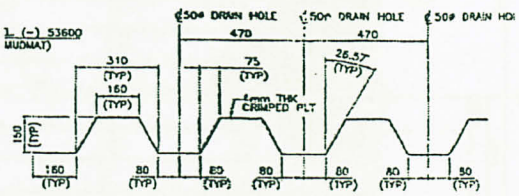
TYPICAL JOINT DETAILS OF CRIMPED PLT. TO CRIMPED PLT.
SCALE 1:10

G Total Weight

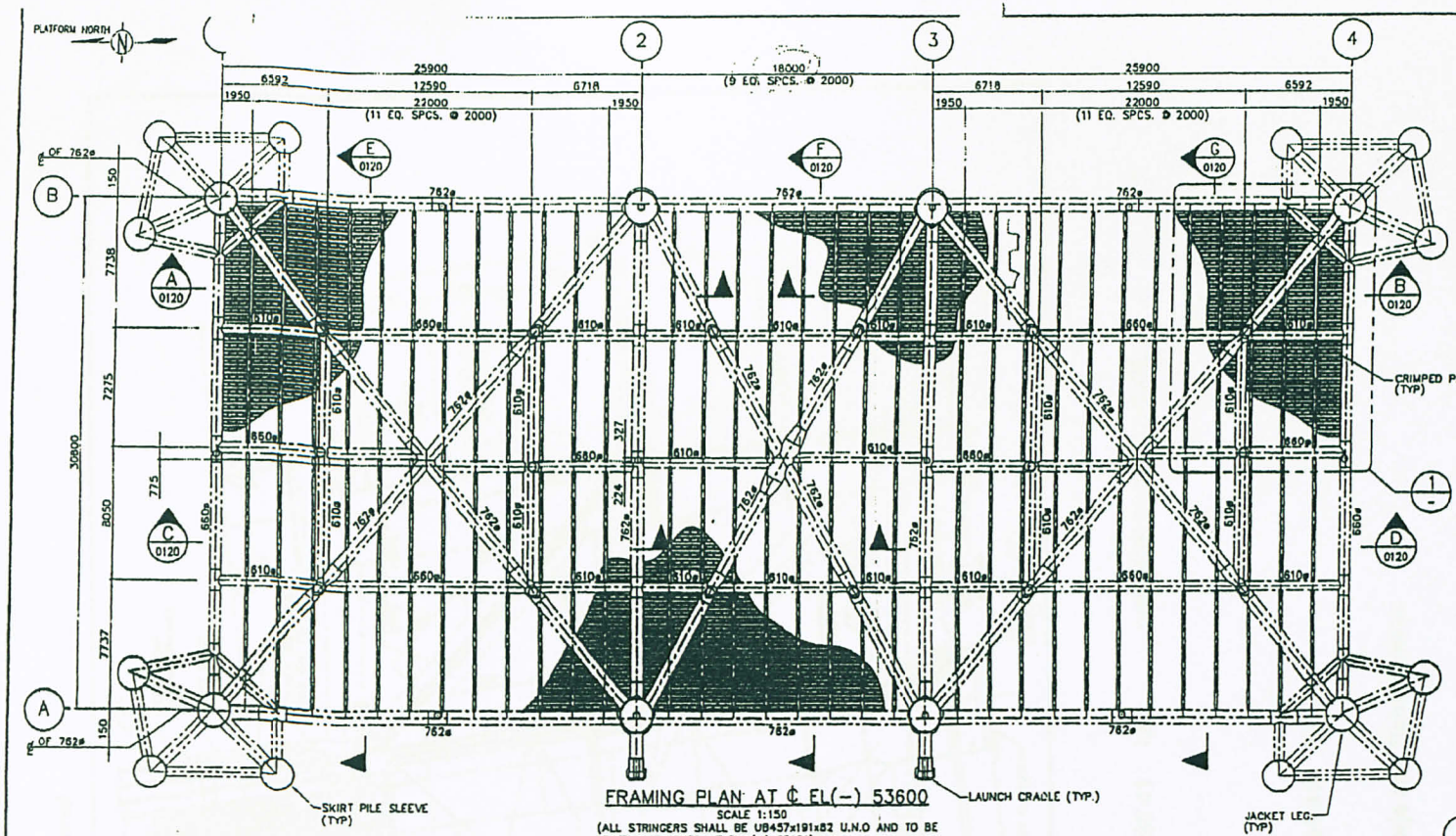
Total weight	=	1096.40	kN

THEREFORE,

TOTAL WEIGHT	=	1096.40	kN



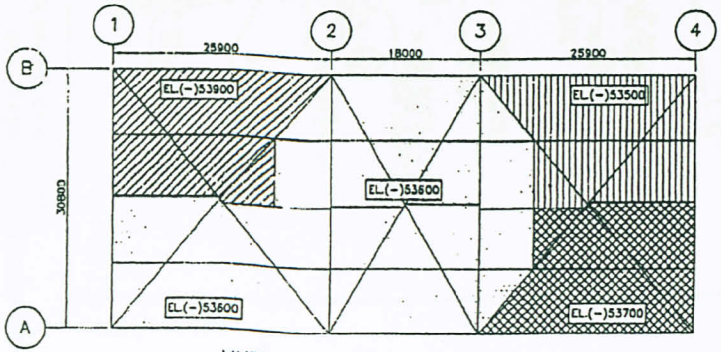
TYPICAL CRIMPED PLT. DETAIL



FRAMING PLAN AT ℄ EL(−) 53600

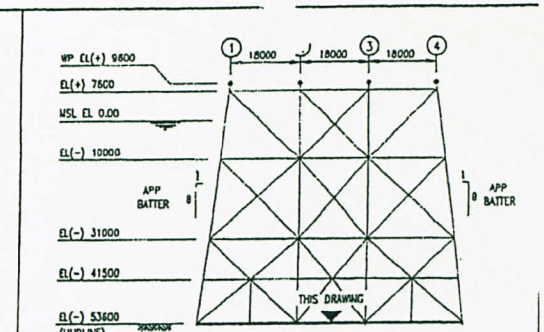
SCALE 1:150

(ALL STRINGERS SHALL BE UB457x191x82 U.N.O AND TO BE BOTTOM FLUSHED AT EL. (−) 53981)



MUDMAT ARRANGEMENT LAYOUT PLAN

SCALE 1:300



KEY ELEVATION

N.T.S

NOTES:

1. THE MUDMAT HAS BEEN DESIGNED FOR FOLLOWING PILE SEQUENCES :-

SEQUENCES 1:

a. JACKET UPENDED AND LOWERED DOWN TO MUDLINE.
b. FLOOD ALL JACKET LEGS, BUOYANCY TANKS AND CAISSON.

SEQUENCES 2:

a. REMOVE ALL BUOYANCY TANKS (8 nos) FROM JACKET.

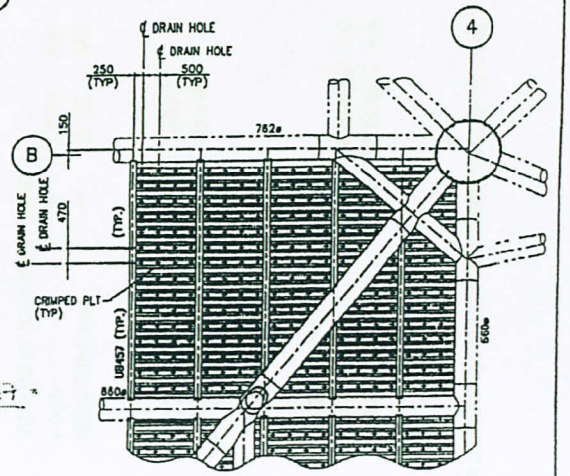
SEQUENCES 3:

a. P1 @ A1
b. P1 @ B4
c. STAB P2 @ ON TOP P1 @ A1
d. STAB P2 @ ON TOP P1 @ B4
e. WELD P1 + P2 @ A1
f. WELD P1 + P2 @ B4
g. LOWER P1 + P2 @ A1 TO ALLOW SELF PENETRATION

SEQUENCES 4:

a. P1 @ A4
b. P1 @ B1
c. STAB P2 @ ON TOP P1 @ A4
d. STAB P2 @ ON TOP P1 @ B1.
e. WELD P1 + P2 @ A4

2. SEQUENCE 3 & 4 MAY BE INTERCHANGED BY OIC



DETAIL 1/- SCALE 1:75

(TYPICAL ARRANGEMENT OF DRAIN HOLES AT THE BOTTOM OF THE CRIMPED PLT)

NOTE :

1. FOR GENERAL NOTES SEE DRAWING NO. BCPA2-DR-SJ-0002.
2. ALL ELEVATIONS AND DIMENSIONS ARE IN MILLIMETERS.
3. ALL MATERIALS ON THIS DRAWING SHALL BE GRADE 2-C U.N.O.

APPROVED REV. NO.

SCALE : AS-SHOWN
DRAWN : WZA
DATE : 06.11.08
CHKD : NA
DATE : NA
APPROVED : NA
DATE : NA

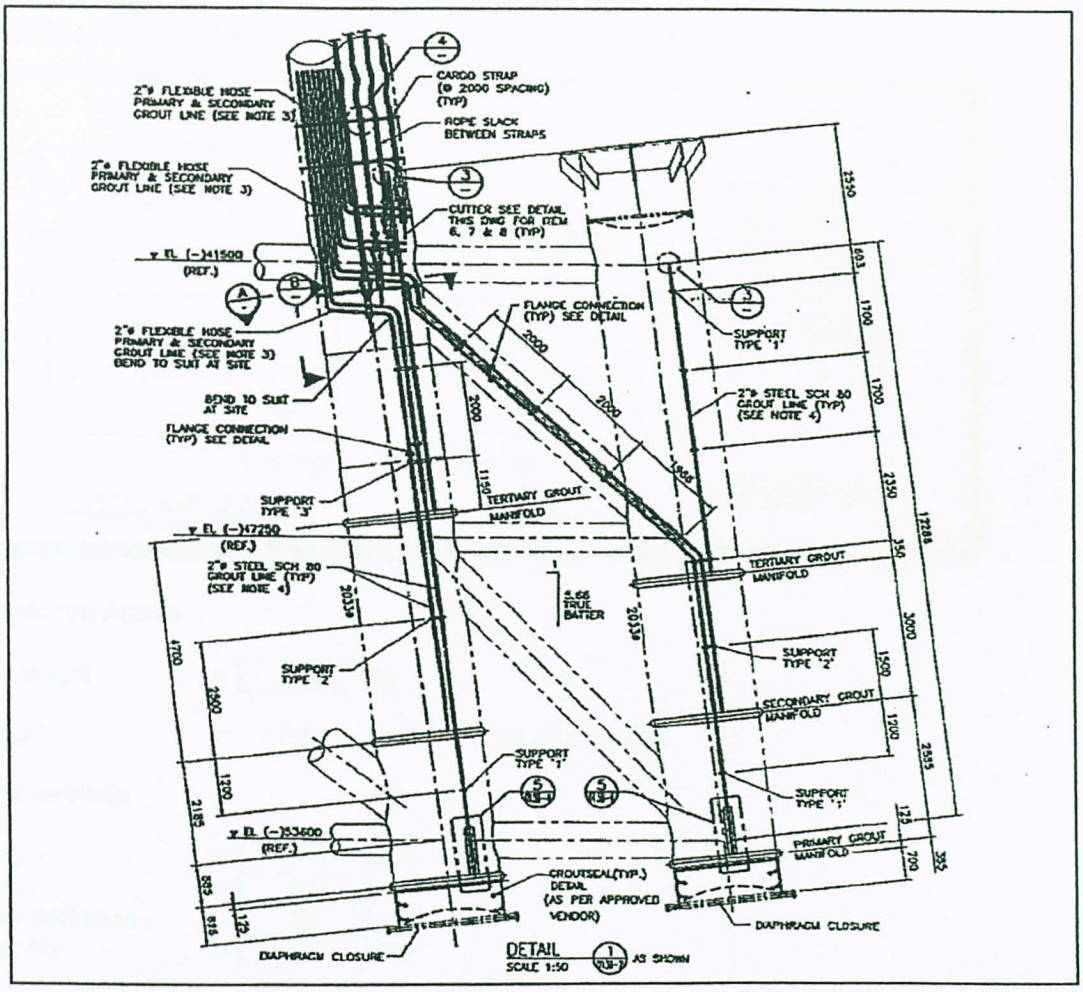
OIL AND NATURAL GAS CORPORATION LIMITED, INDIA

BCPA-2 JACKET

MUDMAT LAYOUT PLAN

VASAI EAST DEVELOPMENT PROJECT BCPA-2 PROCESS PLATFORM

Appurtenances: Grouting Line
Ref: BCPA2 Jacket Model



A Total Weight

Grout line weight = 98.41 kN weight taken from VoCAD from BCPA-2

THEREFORE,

TOTAL WEIGHT = 98.410 kN

B Weight Distribution at Legs and Skirt Sleeves

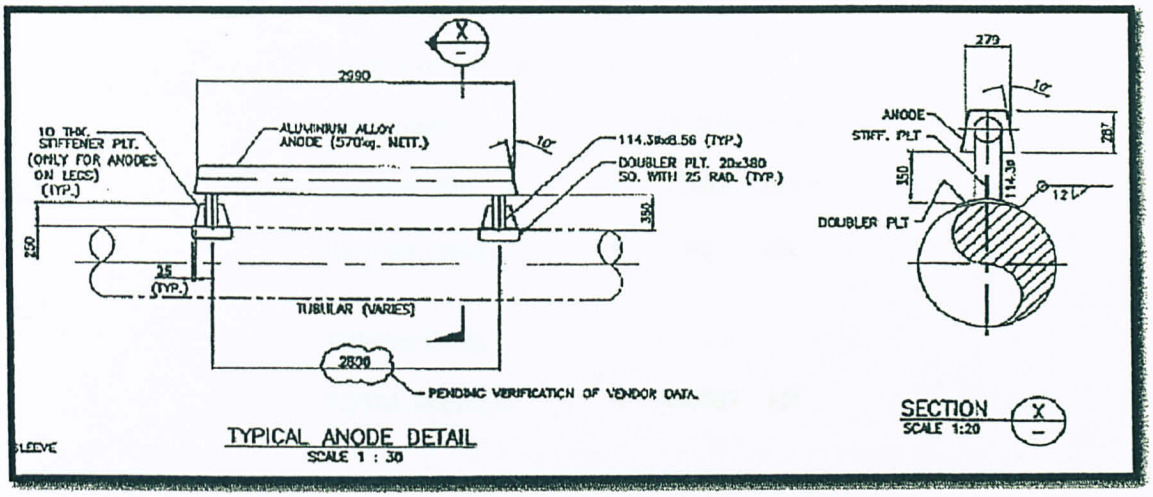
Weight in previous model
Legs = 3.584 MT
Skirt Sleeves = 2.16 MT

Percentage weight at
Legs = 62.39554
Skirt Sleeves = 37.60446

Therefore

Total weigth at
Legs = 61.40345 kN at 32 locations
Skirt Sleeves = 37.00655 kN at 36 locations

Appurtenances: Anode
Drawing Ref No: BCPA2-DR-EL-0900 / 5 / 1



A Aluminium Anode

Unit weight	=	570	kg	
Weight	=	5.59	kN	for each anode

B Doubler Plate

Length	=	279	mm	
Width	=	380	mm	
Plate thickness	=	20	mm	
Quantity	=	2	nos.	
Area	=	0.106	m2	
Volume	=	0.002	m3	
Weight	=	0.33	kN	for each anode

E Pipe

Outer diameter	=	114.3	mm	
Length	=	700	mm	
Thickness	=	8.56	mm	
Quantity	=	1	nos.	
Area	=	0.251	m2	
Volume	=	0.002	m3	
Weight	=	0.17	kN	for each anode

G Total Weight

Quantity	=	520	nos.	
TOTAL WEIGHT	=	**3416.76**	kN	with contingency 10% at 520 location

Appurtenances: Handrail
Ref: BCPA2 -DR-SJ-0129-2 Jacket Model

A Total Weight

Assume use 114 ø x 6.3 wt

Total length	=	271838	mm
Handrail UDL	=	0.164	kN/m
Handrail Weight	=	45	kN

THEREFORE,

TOTAL WEIGHT	**=**	**44.581**	**kN**

Appurtenances: Grating
Ref: BCPA2 -DR-SJ-0129-2 Jacket Model

A Area Covered by Grating

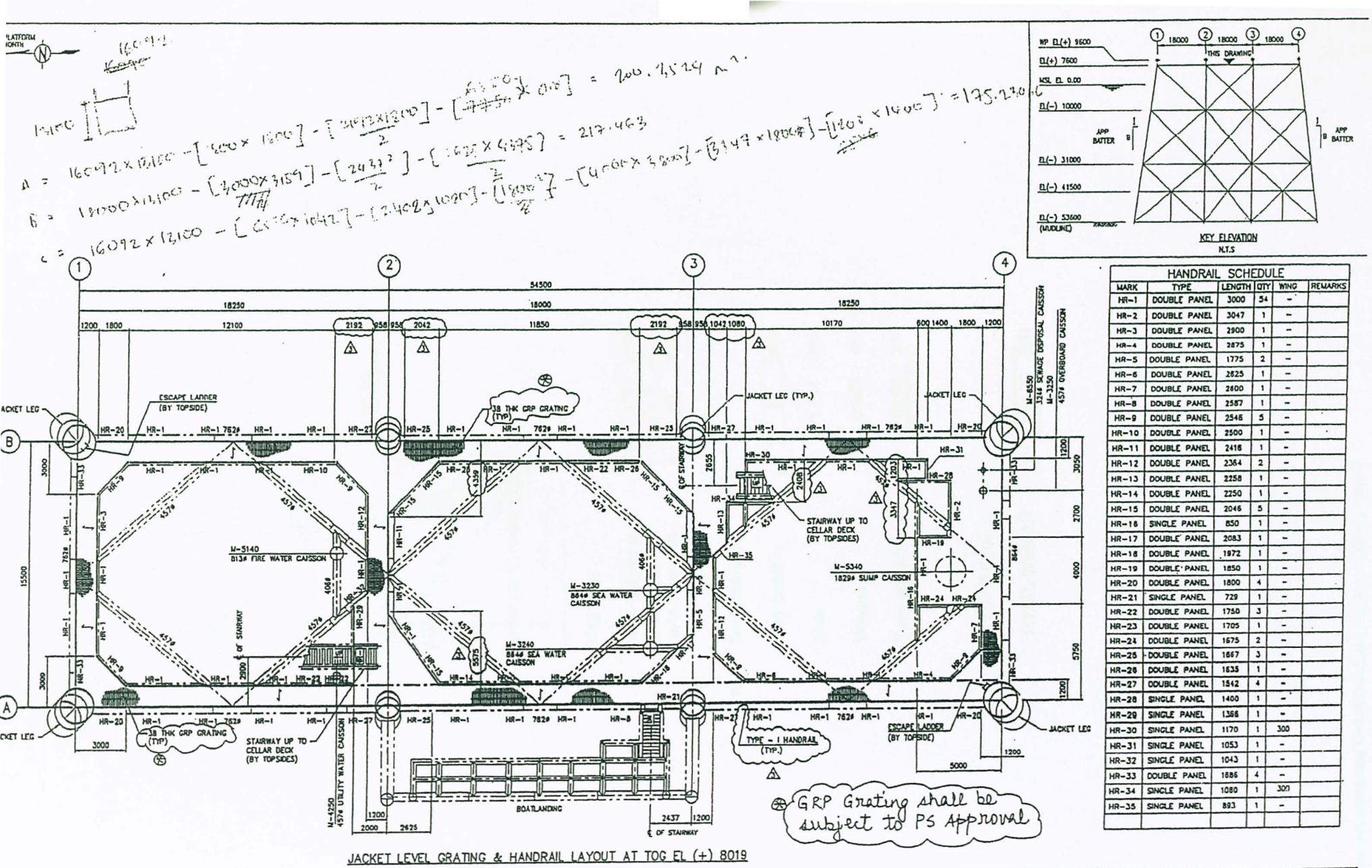
Total Area of Deck EL(+) 8019	=	**844750000.00**	mm2	
Area not covered by grating		A	=	200.35 m2
		B	=	217.46 m2
		C	=	175.23 m2
		Total		593.04 m2
Total Area Covered by Grating	=	251.710	m2	

B Total Weight

Total Grating Area	=	251.710	m2
Grating UDL	=	0.48	kN/m2
Handrail Weight	=	121	kN

THEREFORE,

TOTAL WEIGHT	=	**120.821**	**kN**



JACKET LEVEL GRATING & HANDRAIL LAYOUT AT TOG EL (+) 8019

HANDRAIL SCHEDULE

MARK	TYPE	LENGTH	QTY	WING	REMARKS
HR-1	DOUBLE PANEL	3000	54	–	
HR-2	DOUBLE PANEL	3047	1	–	
HR-3	DOUBLE PANEL	2900	1	–	
HR-4	DOUBLE PANEL	2875	1	–	
HR-5	DOUBLE PANEL	1775	2	–	
HR-6	DOUBLE PANEL	2825	1	–	
HR-7	DOUBLE PANEL	2800	1	–	
HR-8	DOUBLE PANEL	2587	1	–	
HR-9	DOUBLE PANEL	2546	5	–	
HR-10	DOUBLE PANEL	2500	1	–	
HR-11	DOUBLE PANEL	2416	1	–	
HR-12	DOUBLE PANEL	2364	2	–	
HR-13	DOUBLE PANEL	2258	1	–	
HR-14	DOUBLE PANEL	2250	1	–	
HR-15	DOUBLE PANEL	2046	5	–	
HR-16	SINGLE PANEL	850	1	–	
HR-17	DOUBLE PANEL	2083	1	–	
HR-18	DOUBLE PANEL	1972	1	–	
HR-19	DOUBLE PANEL	1850	1	–	
HR-20	DOUBLE PANEL	1800	4	–	
HR-21	SINGLE PANEL	729	1	–	
HR-22	DOUBLE PANEL	1750	3	–	
HR-23	DOUBLE PANEL	1705	1	–	
HR-24	DOUBLE PANEL	1675	2	–	
HR-25	DOUBLE PANEL	1667	3	–	
HR-26	DOUBLE PANEL	1635	1	–	
HR-27	DOUBLE PANEL	1542	4	–	
HR-28	SINGLE PANEL	1400	1	–	
HR-29	SINGLE PANEL	1368	1	–	
HR-30	SINGLE PANEL	1170	1	300	
HR-31	SINGLE PANEL	1053	1	–	
HR-32	SINGLE PANEL	1043	1	–	
HR-33	DOUBLE PANEL	1686	4	–	
HR-34	SINGLE PANEL	1080	1	300	
HR-35	SINGLE PANEL	893	1	–	

S:
OR GENERAL NOTES, SEE DRAWING NO. BCPA2-DR-SJ-0002.
LL ELEVATIONS AND DIMENSIONS ARE IN MILLIMETERS.
OR HANDRAIL DETAILS REFER TO DWG. NO. BCPA2-DR-SJ-0005.
OR GRATING FIXING DETAILS REFER TO DWG NO. BCPA2-DR-SJ-0004.

APPROVED REV. NO. 3

3	21.05.07	APPROVED FOR CONSTRUCTION (AFC)				
2	12.12.07	APPROVED FOR CONSTRUCTION (AFC)				
1	24.05.07	APPROVED FOR CONSTRUCTION (AFC)				
0	15.01.07	ISSUED FOR APPROVAL/APPROVED FOR				

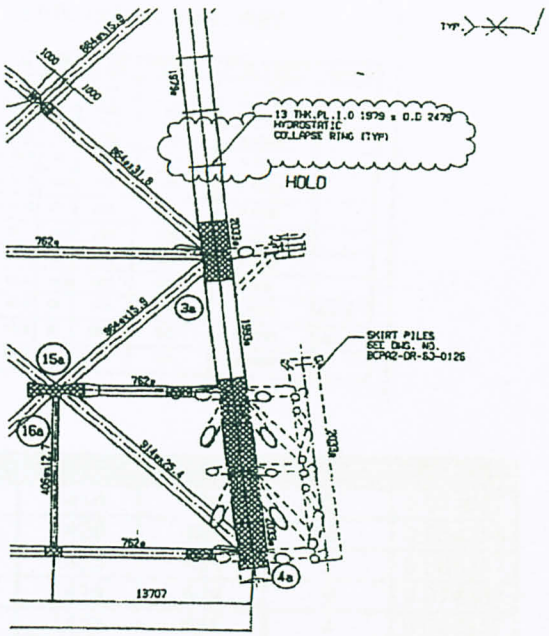
SCALE : 1:125
SHEETS : 28
DATE : 15.04.06
DWG : NA
DATE : NA
APPROVED : NA
DATE : NA

OIL AND NATURAL GAS CORPORATION LIMITED, INDIA

BCPA-2 JACKET
JACKET LEVEL
GRATING AND HANDRAIL LAYOUT

ENGINEERS INDIA LIMITED
LEAD CONTRACTOR: HEAVY INDUSTRIES
VASAI EAST DEVELOPMENT PROJECT BCPA-2 PROCESS PLATFORM
DOC. NO. & SHEET NO. BCPA2-DR-SJ-0129-2 REV. 1 OF 1

Appurtenances: Hydrostatic Collapse Ring
Drawing Ref No: BCPA2-DR-SJ-0103-2



A Ring Size

Outer diameter	=	2479	mm
Inner diameter	=	1979	mm
Plate thickness	=	13	mm

B Total Weight

Ring quantity	=	32	nos.
Area	=	1.751	m2
Volume	=	0.023	m3
Total weight	=	**56.08**	kN

THEREFORE,

TOTAL WEIGHT = 56.08 kN

Appurtenances: Joint Ring
Drawing Ref No: BCPA2-DR-SJ-0105-2

A Ring Size

TYPICAL INTERNAL RING PLATE

DETAIL NUMBER	JACKET LEG	RING PLT.	OUT DIA. (O.D.)	INSIDE DIA. (I.D.)	RINGS REQUIRED AT EACH JOINT	REMARKS
"1"	1524ø x 55.2	52	1414	414	6 RINGS	
"2"	1524ø x 52	44.5	1420	420	4 RINGS	
"3"	1524ø x 44.5	44.5	1435	435	2 RINGS	
"4"	1524ø x 55.2	52	1414	414	6 RINGS	
"5"	1524ø x 44.5	44.5	1435	435	4 RINGS	
"6"	1524ø x 44.5	30	1435	435	3 RINGS	
"6a"	1524ø x 52	44.5	1420	420	3 RINGS	
"7"	2033ø x 55.2	52	1923	523	3 RINGS	
	2033ø x 55.2	44.5	1923	523	1 RING	
"8"	1524ø x 55.2	52	1414	414	4 RINGS	ROW "8"
"9"	2033ø x 55.2	52	1923	523	2 RINGS	ROW "8"
"10"	1524ø x 55.2	44.5	1414	414	3 RINGS	

Detail no:	Thickness	OD	ID	Quantity	Volume
1	52.0	1414	414	6	0.074657
2	44.5	1420	420	4	0.064308
3	44.5	1435	435	2	0.065357
4	52.0	1414	414	6	0.074657
5	44.5	1435	435	4	0.065357
6	30.0	1435	435	3	0.044061
6a	44.5	1420	420	3	0.064308
7	52.0	1923	523	3	0.139855
	44.5	1923	523	1	0.119684
8	52.0	1414	414	4	0.074657
9	52.0	1923	923	2	0.116233
10	44.5	1414	414	3	0.063889
				Total	0.967022 m3

B Total Weight

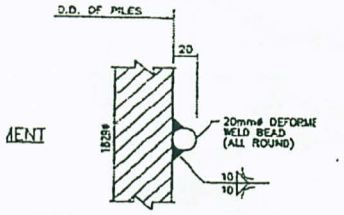
Volume = 0.967 m3

Total weight = **148.94** kN At Row '2' & '3'

THEREFORE,

TOTAL WEIGHT = 193.62 kN TOTAL Joint Ring with 1.3 Contigency

Appurtenances: Bead at skirt pile
Drawing Ref No: BCPA2-DR-SJ-0150-2



TYPICAL WELD BEAD DETAILS
N.T.S.

A Plate Size

Diameter Leg	=	2033	mm
Diameter weld Bead	=	20	mm
Length	=	6387	mm

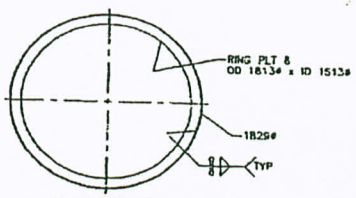
B Total Weight

Quantity	=	31	nos.	at each main pile
Area	=	0.00031	m2	
Volume	=	0.062	m3	
Total weight	=	**4.79**	kN	at each main pile

THEREFORE,

TOTAL WEIGHT	=	**57.48**	**kN**	**TOTAL AT 4 main pile**

Appurtenances: Bouyancy Tank Ring
Drawing Ref No: BCPA2-DR-SJ-0141



TYPICAL DETAIL OF INTERNAL RING STIFFENER FOR BUOYANCY TANKS

A Ring Size 1

Outer diameter	=	1813	mm
Inner diameter	=	1513	mm
Plate thickness	=	8	mm

B Total Weight 1

Ring quantity	=	52	nos.
Area	=	0.784	m2
Volume	=	0.006	m3
Total weight	=	**25.11**	kN

THEREFORE,

TOTAL WEIGHT = ***50.21*** **kN**

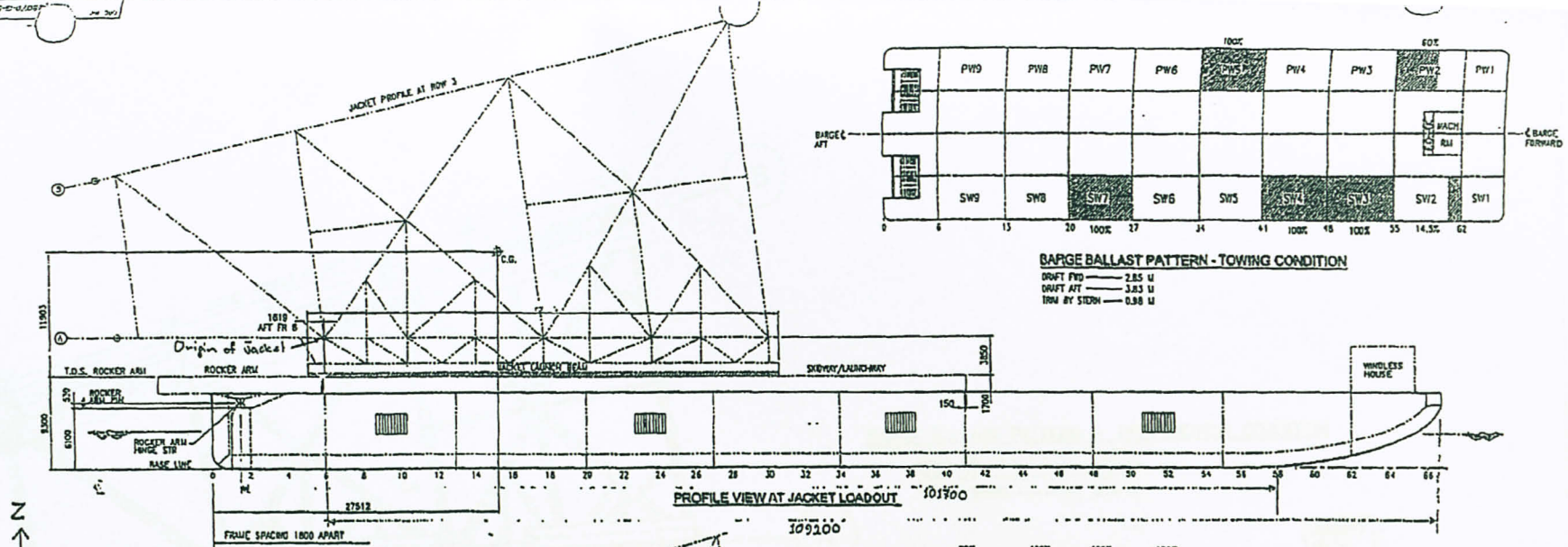
C **Ring Size drawing for buoyancy tank 2 & 3 are not available so assume similar weight in previous applied**

APPENDIX 2-1 : Jacket Arrangement on Barge During Launch

APPENDIX 2-2 : Launch Trajectory (-50% trim)

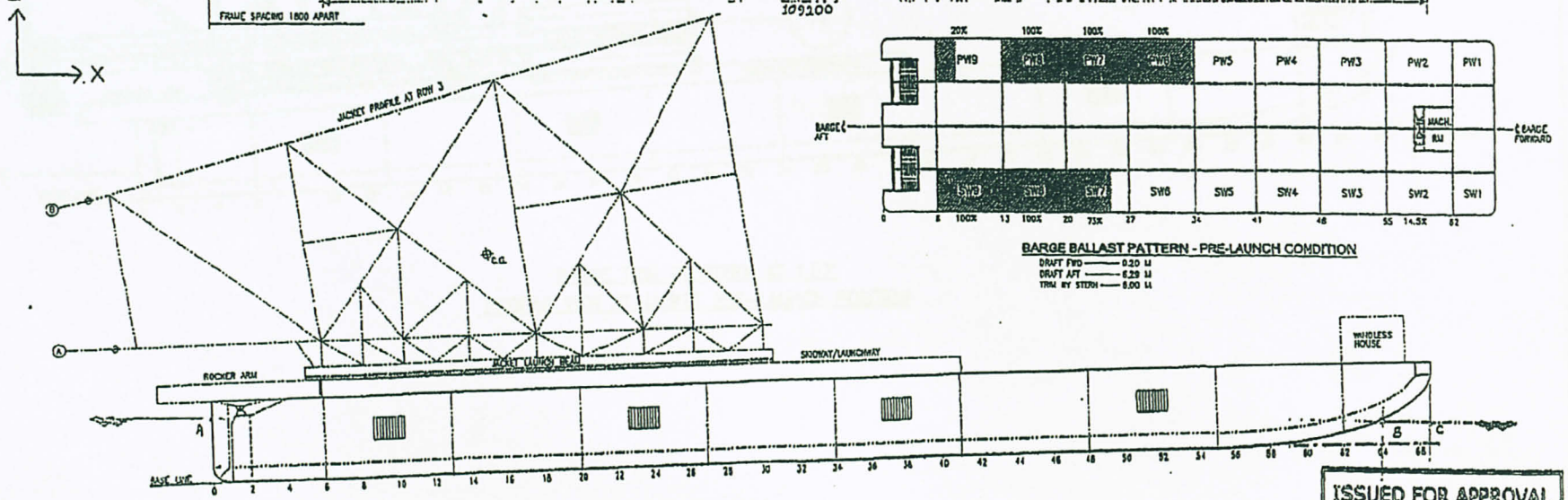
APPENDIX 2-3 : Launch Trajectory (+50% trim)

APPENDIX 2-4 : Launch Trajectory (Normal)



BARGE BALLAST PATTERN - TOWING CONDITION

DRAFT FWD —— 2.85 M
DRAFT AFT —— 3.83 M
TRIM BY STERN —— 0.98 M



BARGE BALLAST PATTERN - PRE-LAUNCH CONDITION

DRAFT FWD —— 0.20 M
DRAFT AFT —— 6.29 M
TRIM BY STERN —— 6.00 M

ISSUED FOR APPROVAL
DATE: 31OCT06

29 International Business Park
307-03 Acer Building Tower 3
Singapore 609923
Tel (65) 68995970
Fax (65) 65651229

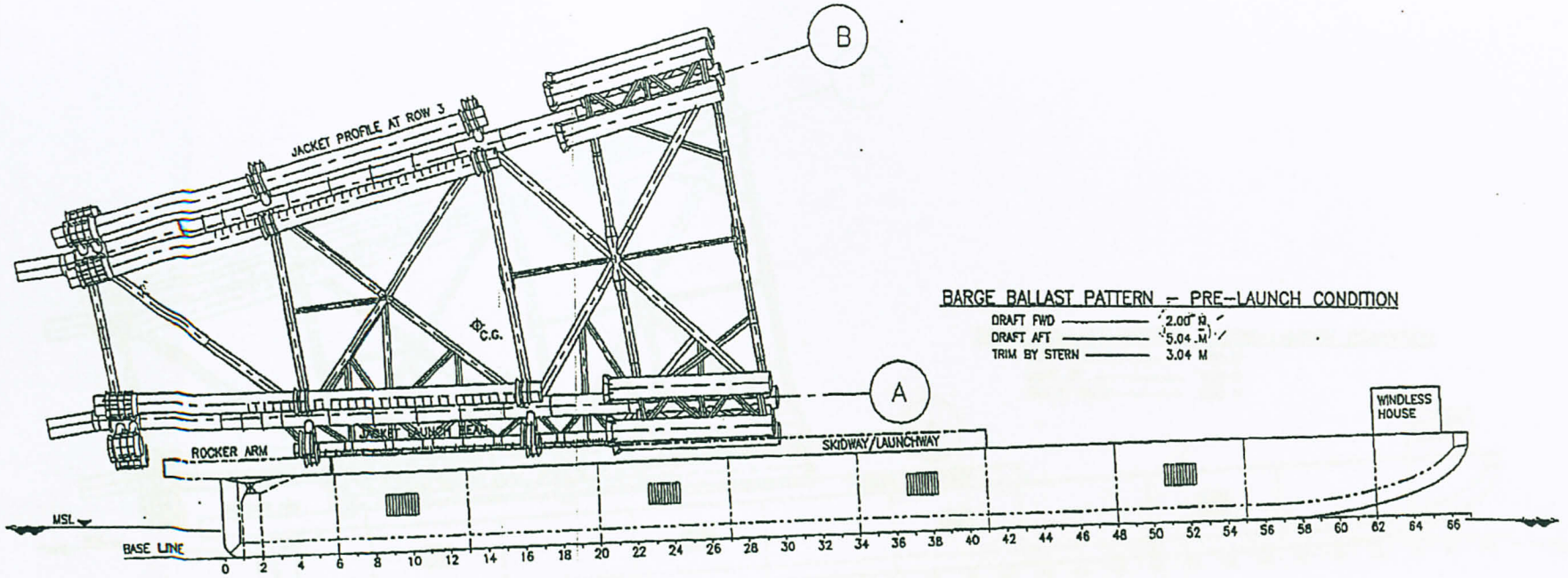
REV	DATE	REVISION DESCRIPTION	DRAWN	CHECKED	DESIGNED	APPROVED	CLIENT
B	31OCT06	RE-DESIGNED STERN END AND ISSUED FOR APPROVAL	HOSC	YAT	S.RAMANI	O.L.O	
A	19OCT06	ISSUED FOR APPROVAL	HOSC	YAT	S.RAMANI	O.L.O	

CLIENT: UNI-BULK HOLDINGS PTE. LTD.

DRAWN: HOSC DATE: OCT'06
CHECKED: AYWEO DATE: OCT'06
DESIGNED: S.RAMANI DATE: OCT'06
APPROVED: O.L.O DATE: OCT'06
CLIENT: DATE:

TITLE: MODIFICATION OF CARGO BARGE TO LAUNCH BARGE
GENERAL ARRANGEMENT SHT 2/2

SCALE: 200 DRG No. MES-06070-S-D-GC02 REV B

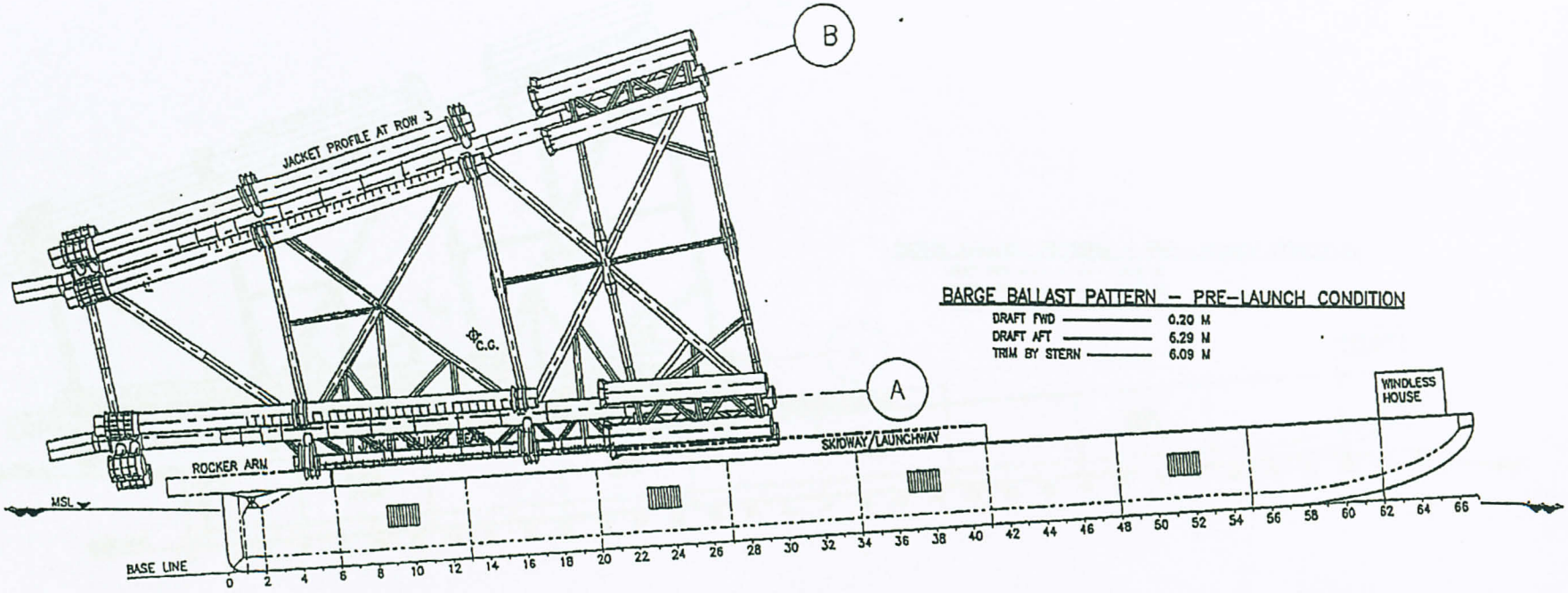


BARGE BALLAST PATTERN – PRE-LAUNCH CONDITION

DRAFT FWD	2.00 M
DRAFT AFT	5.04 M
TRIM BY STERN	3.04 M

BARGE TRIM BY STERN AT 1.67°

PROFILE VIEW AT JACKET PRE-LAUNCH POSITION

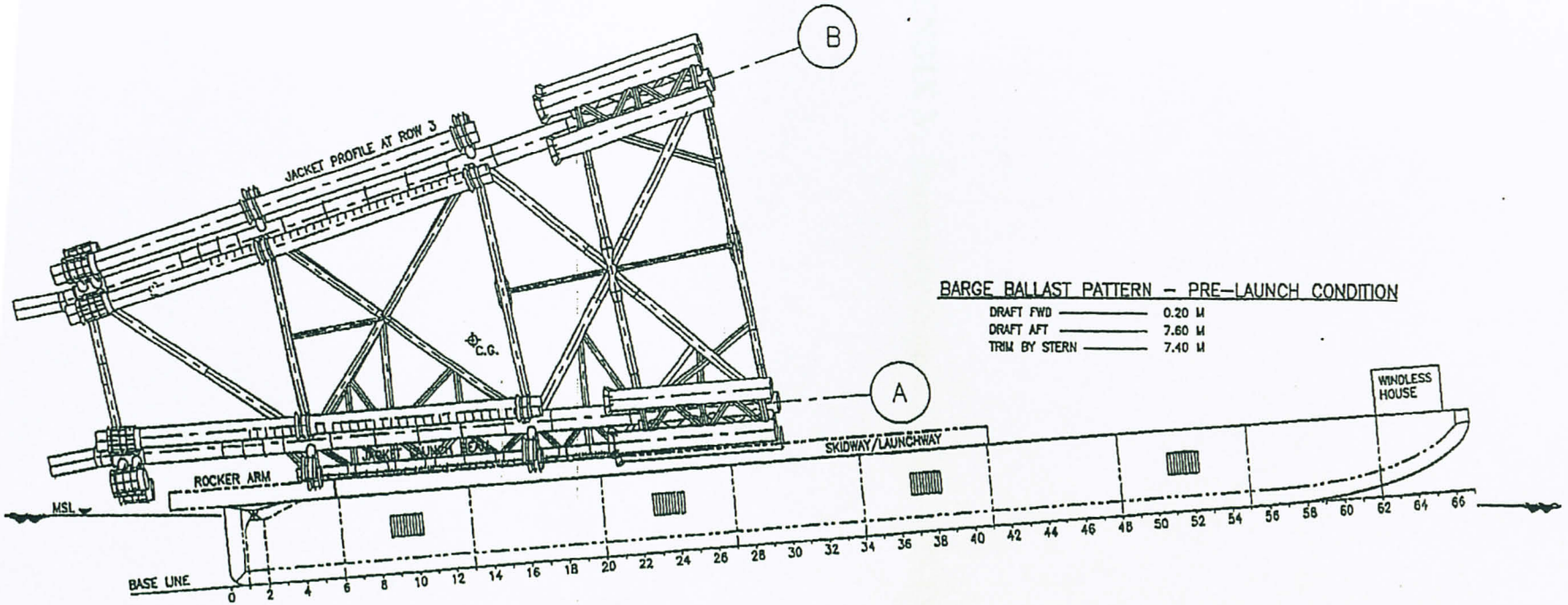


BARGE BALLAST PATTERN – PRE-LAUNCH CONDITION

DRAFT FWD	0.20 M
DRAFT AFT	6.29 M
TRIM BY STERN	6.09 M

BARGE TRIM BY STERN AT 3.34°

PROFILE VIEW AT JACKET PRE-LAUNCH POSITION



BARGE BALLAST PATTERN – PRE–LAUNCH CONDITION

DRAFT FWD	0.20 M
DRAFT AFT	7.60 M
TRIM BY STERN	7.40 M

BARGE TRIM BY STERN AT 4.06°

PROFILE VIEW AT JACKET PRE–LAUNCH POSITION

APPENDIX 3 : Trajectory Output Listing – 8% Contingency with COG Shift

*** FRICTION DESCRIPTION ***

VELOCITY M/SEC	FRICTION COEFF.
0.000	0.150
0.010	0.060
1.000	0.060
50.000	0.060

********** JACKET PROPERTIES **********

NUMBER OF JOINTS 734
NUMBER OF MEMBERS 1336
NUMBER OF PLATES 0
NUMBER OF ADDITIONAL WEIGHTS 498
NUMBER OF DRAG AREAS 8
NUMBER OF MEMBER SEGMENTS 3

MATERIAL DENSITY 7.850 MT/M**3
SEAWATER DENSITY 1.030 MT/M**3
TOTAL WEIGHT ..... 4348.550 TONNES
TOTAL BUOYANCY ..... 5562.850 TONNES
CENTER OF GRAVITY
XCG ..... 0.851 M
YCG ..... 18.717 M
ZCG ..... 14.576 M

MASS MOMENTS OF INERTIA

IXX 2455717120.000 KG-M**2
IYY 3300236032.000 KG-M**2
IZZ 4451223040.000 KG-M**2
IXY 63914276.000 KG-M**2
IXZ 3071108.250 KG-M**2
IYZ ..... -150196096.000 KG-M**2

SUBMERGED CENTER OF BUOYANCY
XCB ..... 0.288 M
YCB ..... 18.031 M
ZCB ..... 16.072 M

******* COMPONENT WEIGHT AND CG LOCATION *******

ITEM	WEIGHT TONNES	XCG M	YCG M	ZCG M
MEMBERS	3633.2	0.95	18.23	14.65
PLATES	0.0	0.00	0.00	0.00
ADD WTS	715.3	0.37	21.20	14.20
* TOTAL *	4348.6	0.85	18.72	14.58

DISTANCE FROM BARGE FWD END
TO JOINT UC50 ..... 93.600 M
TO JACKET LOWER FWD END ..... 48.659 M

DISTANCE FROM BARGE CENTER
TO JACKET CENTERLINE ..... 0.000 M

********** CONTINGENCY JACKET PROPERTIES **********

TOTAL WEIGHT ..... 4696.435 TONNES
CENTER OF GRAVITY
XCG ..... 0.851 M
YCG ..... 18.067 M
ZCG ..... 14.576 M

********** BARGE PROPERTIES **********

HEIGHT	7.600	M
WIDTH	33.500	M
BOTTOM LENGTH	104.400	M
FWD END SLOPE PROJECTION	15.600	M
AFT END SLOPE PROJECTION	0.000	M
SKID HEIGHT	2.300	M
ROCKER ARM POSITION	101.700	M
ROCKER ARM DEPTH	2.722	M
FWD END INITIAL DRAFT	2.000	M
AFT END INITIAL DRAFT	5.040	M
INITIAL ROLL ANGLE	0.000	DEG
INITIAL PITCH ANGLE	-1.669	DEG
INITIAL YAW ANGLE	0.000	DEG
WEIGHT	8122.889	TONNES
MASS	8122890.000	KG
BARGE RADIUS OF GYRATION (ROLL)	4.835	M
(PITCH)	32.389	M
(YAW)	32.389	M
CENTER OF GRAVITY - X	58.168	M
- Y	-0.492	M
- Z	3.040	M
INITIAL CENTER OF BUOYANCY - X	59.106	M
- Y	0.000	M
WINCH SPEED	0.166	M/SEC
DRAG COEFFICIENT	1.000	
ADDED MASS COEFFICIENT	1.000	
INCREMENT LENGTH FOR BOTTOM	5.220	M
END SLOPES	0.380	M
INITIAL JACKET ANGLE (ROLL)	0.000	DEG
(PITCH)	0.000	DEG
(YAW)	0.000	DEG
JACKET RADIUS OF GYRATION (ROLL)	23.764	M
(PITCH)	27.549	M
(YAW)	31.994	M
DISTANCE FROM JACKET END TO PIN	-68.641	M
INITIAL JACKET COORD. X	2.387	M
Y	0.851	M
Z	20.721	M
THETA X	0.000	DEG
THETA Y	1.668	DEG
THETA Z	0.000	DEG
INITIAL BARGE COORD. X	0.000	M
Y	-0.492	M
Z	-0.655	M
THETA X	0.000	DEG
THETA Y	1.669	DEG
THETA Z	0.000	DEG

P H A S E 1 M O T I O N

TIME (SECS)	BARGE/LAUNCH COORDINATE SYSTEM **** COORDINATES **** X M	Y M	Z M	****** ANGLES ****** PITCH DEG	ROLL DEG	YAW DEG	*** ACCELERATIONS *** X G'S	Y G'S	Z G'S	RELATIVE JACKET MOTION * ROCKER ARM COORD. SYS. * DISPL. M	VEL. M/SEC	ACCEL. G'S	* DISTANCE TO * BEGIN TIPPING * (ESTIMATED) M
0.00	0.0	-0.5	-0.7	1.67	0.00	0.00	0.000	0.000	0.000	-41.77	0.17	0.000	41.26
1.00	0.0	-0.5	-0.7	1.67	0.00	0.00	0.000	0.000	0.000	-41.60	0.17	0.000	41.12
2.00	0.0	-0.5	-0.7	1.69	0.00	0.00	0.000	0.000	0.000	-41.44	0.17	0.000	40.94
3.00	0.0	-0.5	-0.7	1.71	0.00	0.00	0.000	0.000	0.000	-41.27	0.17	0.000	40.74
4.00	0.0	-0.5	-0.7	1.73	0.00	0.00	0.000	0.000	0.000	-41.10	0.17	0.000	40.57
5.00	0.0	-0.5	-0.7	1.73	0.00	0.00	0.000	0.000	0.000	-40.94	0.17	0.000	40.42
6.00	0.0	-0.5	-0.7	1.74	0.00	0.00	0.000	0.000	0.000	-40.77	0.17	0.000	40.27
7.00	0.0	-0.5	-0.7	1.76	0.00	0.00	0.000	0.000	0.000	-40.61	0.17	0.000	40.08
8.00	0.0	-0.5	-0.7	1.78	0.00	0.00	0.000	0.000	0.000	-40.44	0.17	0.000	39.88
9.00	0.0	-0.5	-0.7	1.78	0.00	0.00	0.000	0.000	0.000	-40.27	0.17	0.000	39.73
10.00	0.0	-0.5	-0.7	1.79	0.00	0.00	0.000	0.000	0.000	-40.11	0.17	0.000	39.59
11.00	0.0	-0.5	-0.7	1.80	0.00	0.00	0.000	0.000	0.000	-39.94	0.17	0.000	39.41
12.00	0.0	-0.5	-0.7	1.83	0.00	0.00	0.000	0.000	0.000	-39.78	0.17	0.000	39.21
13.00	0.0	-0.5	-0.7	1.84	0.00	0.00	0.000	0.000	0.000	-39.61	0.17	0.000	39.03
14.00	0.0	-0.5	-0.7	1.85	0.00	0.00	0.000	0.000	0.000	-39.44	0.17	0.000	38.89
15.00	0.0	-0.5	-0.7	1.85	0.00	0.00	0.000	0.000	0.000	-39.28	0.17	0.000	38.74
16.00	0.0	-0.5	-0.7	1.87	0.00	0.00	0.000	0.000	0.000	-39.11	0.17	0.000	38.56
17.00	0.0	-0.5	-0.7	1.89	0.00	0.00	0.000	0.000	0.000	-38.95	0.17	0.000	38.36
18.00	0.0	-0.5	-0.7	1.90	0.00	0.00	0.000	0.000	0.000	-38.78	0.17	0.000	38.19
19.00	0.0	-0.5	-0.7	1.91	0.00	0.00	0.000	0.000	0.000	-38.61	0.17	0.000	38.05
20.00	0.0	-0.5	-0.7	1.92	0.00	0.00	0.000	0.000	0.000	-38.45	0.17	0.000	37.89
21.00	0.0	-0.5	-0.7	1.94	0.00	0.00	0.000	0.000	0.000	-38.28	0.17	0.000	37.69
22.00	0.0	-0.5	-0.7	1.96	0.00	0.00	0.000	0.000	0.000	-38.12	0.17	0.000	37.50
23.00	0.0	-0.5	-0.7	1.96	0.00	0.00	0.000	0.000	0.000	-37.95	0.17	0.000	37.36
24.00	0.0	-0.5	-0.7	1.96	0.00	0.00	0.000	0.000	0.000	-37.78	0.17	0.000	37.22
25.00	0.0	-0.5	-0.7	1.98	0.00	0.00	0.000	0.000	0.000	-37.62	0.17	0.000	37.04
26.00	0.0	-0.5	-0.7	2.01	0.00	0.00	0.000	0.000	0.000	-37.45	0.17	0.000	36.83
27.00	0.0	-0.5	-0.7	2.02	0.00	0.00	0.000	0.000	0.000	-37.29	0.17	0.000	36.65
28.00	0.0	-0.5	-0.7	2.02	0.00	0.00	0.000	0.000	0.000	-37.12	0.17	0.000	36.52
29.00	0.0	-0.5	-0.7	2.03	0.00	0.00	0.000	0.000	0.000	-36.95	0.17	0.000	36.37
30.00	0.0	-0.5	-0.7	2.05	0.00	0.00	0.000	0.000	0.000	-36.79	0.17	0.000	36.18
31.00	-0.1	-0.5	-0.7	2.07	0.00	0.00	0.000	0.000	0.000	-36.62	0.17	0.000	35.97
32.00	-0.1	-0.5	-0.7	2.08	0.00	0.00	0.000	0.000	0.000	-36.46	0.17	0.000	35.81
33.00	-0.1	-0.5	-0.7	2.08	0.00	0.00	0.000	0.000	0.000	-36.29	0.17	0.000	35.68
34.00	-0.1	-0.5	-0.7	2.09	0.00	0.00	0.000	0.000	0.000	-36.12	0.17	0.000	35.51
35.00	-0.1	-0.5	-0.7	2.12	0.00	0.00	0.000	0.000	0.000	-35.96	0.17	0.000	35.31
36.00	-0.1	-0.5	-0.7	2.14	0.00	0.00	0.000	0.000	0.000	-35.79	0.17	0.000	35.12
37.00	-0.1	-0.5	-0.7	2.14	0.00	0.00	0.000	0.000	0.000	-35.63	0.17	0.000	34.98
38.00	-0.1	-0.5	-0.7	2.14	0.00	0.00	0.000	0.000	0.000	-35.46	0.17	0.000	34.84
39.00	-0.1	-0.5	-0.7	2.16	0.00	0.00	0.000	0.000	0.000	-35.29	0.17	0.000	34.66
40.00	-0.1	-0.5	-0.7	2.19	0.00	0.00	0.000	0.000	0.000	-35.13	0.17	0.000	34.45
41.00	-0.1	-0.5	-0.7	2.20	0.00	0.00	0.000	0.000	0.000	-34.96	0.17	0.000	34.27
42.00	-0.1	-0.5	-0.7	2.20	0.00	0.00	0.000	0.000	0.000	-34.80	0.17	0.000	34.14
43.00	-0.1	-0.5	-0.7	2.21	0.00	0.00	0.000	0.000	0.000	-34.63	0.17	0.000	33.99
44.00	-0.1	-0.5	-0.7	2.23	0.00	0.00	0.000	0.000	0.000	-34.46	0.17	0.000	33.80
45.00	-0.1	-0.5	-0.7	2.25	0.00	0.00	0.000	0.000	0.000	-34.30	0.17	0.000	33.59
46.00	-0.1	-0.5	-0.7	2.26	0.00	0.00	0.000	0.000	0.000	-34.13	0.17	0.000	33.43
47.00	-0.1	-0.5	-0.7	2.26	0.00	0.00	0.000	0.000	0.000	-33.97	0.17	0.000	33.30

P H A S E 1 M O T I O N

TIME (SECS)	BARGE/LAUNCH COORDINATE SYSTEM **** COORDINATES **** X M	Y M	Z M	****** ANGLES ****** PITCH DEG	ROLL DEG	YAW DEG	*** ACCELERATIONS *** X G'S	Y G'S	Z G'S	RELATIVE JACKET MOTION * ROCKER ARM COORD. SYS. * DISPL. M	VEL. M/SEC	ACCEL. G'S	* DISTANCE TO * BEGIN TIPPING * (ESTIMATED) M
48.00	-0.1	-0.5	-0.7	2.27	0.00	0.00	0.000	0.000	0.000	-33.80	0.17	0.000	33.14
49.00	-0.1	-0.5	-0.7	2.30	0.00	0.00	0.000	0.000	0.000	-33.63	0.17	0.000	32.93
50.00	-0.1	-0.5	-0.7	2.32	0.00	0.00	0.000	0.000	0.000	-33.47	0.17	0.000	32.73
51.00	-0.1	-0.5	-0.7	2.32	0.00	0.00	0.000	0.000	0.000	-33.30	0.17	0.000	32.60
52.00	-0.1	-0.5	-0.7	2.32	0.00	0.00	0.000	0.000	0.000	-33.14	0.17	0.000	32.47
53.00	-0.1	-0.5	-0.7	2.34	0.00	0.00	0.000	0.000	0.000	-32.97	0.17	0.000	32.28
54.00	-0.1	-0.5	-0.7	2.37	0.00	0.00	0.000	0.000	0.000	-32.80	0.17	0.000	32.07
55.00	-0.1	-0.5	-0.7	2.39	0.00	0.00	0.000	0.000	0.000	-32.64	0.17	0.000	31.89
56.00	-0.1	-0.5	-0.8	2.39	0.00	0.00	0.000	0.000	0.000	-32.47	0.17	0.000	31.76
57.00	-0.1	-0.5	-0.8	2.39	0.00	0.00	0.000	0.000	0.000	-32.31	0.17	0.000	31.62
58.00	-0.1	-0.5	-0.8	2.41	0.00	0.00	0.000	0.000	0.000	-32.14	0.17	0.000	31.42
59.00	-0.1	-0.5	-0.8	2.44	0.00	0.00	0.000	0.000	0.000	-31.97	0.17	0.000	31.21
60.00	-0.1	-0.5	-0.8	2.45	0.00	0.00	0.000	0.000	0.000	-31.81	0.17	0.000	31.05
61.00	-0.1	-0.5	-0.8	2.45	0.00	0.00	0.000	0.000	0.000	-31.64	0.17	0.000	30.92
62.00	-0.1	-0.5	-0.8	2.45	0.00	0.00	0.000	0.000	0.000	-31.48	0.17	0.000	30.77
63.00	-0.1	-0.5	-0.8	2.48	0.00	0.00	0.000	0.000	0.000	-31.31	0.17	0.000	30.55
64.00	-0.1	-0.5	-0.8	2.51	0.00	0.01	0.000	0.000	0.000	-31.14	0.17	0.000	30.35
65.00	-0.1	-0.5	-0.8	2.51	0.00	0.01	0.000	0.000	0.000	-30.98	0.17	0.000	30.21
66.00	-0.1	-0.5	-0.8	2.51	0.00	0.01	0.000	0.000	0.000	-30.81	0.17	0.000	30.09
67.00	-0.1	-0.5	-0.8	2.52	0.00	0.01	0.000	0.000	0.000	-30.65	0.17	0.000	29.92
68.00	-0.1	-0.5	-0.8	2.55	0.00	0.01	0.000	0.000	0.000	-30.48	0.17	0.000	29.69
69.00	-0.1	-0.5	-0.8	2.57	0.00	0.01	0.000	0.000	0.000	-30.31	0.17	0.000	29.50
70.00	-0.1	-0.5	-0.8	2.57	0.00	0.01	0.000	0.000	0.000	-30.15	0.17	0.000	29.37
71.00	-0.1	-0.5	-0.8	2.57	0.00	0.01	0.000	0.000	0.000	-29.98	0.17	0.000	29.24
72.00	-0.1	-0.5	-0.8	2.59	0.00	0.01	0.000	0.000	0.000	-29.82	0.17	0.000	29.05
73.00	-0.1	-0.5	-0.8	2.62	0.00	0.01	0.000	0.000	0.000	-29.65	0.17	0.000	28.83
74.00	-0.1	-0.5	-0.8	2.64	0.00	0.01	0.000	0.000	0.000	-29.48	0.17	0.000	28.66
75.00	-0.1	-0.5	-0.8	2.63	0.00	0.01	0.000	0.000	0.000	-29.32	0.17	0.000	28.53
76.00	-0.1	-0.5	-0.8	2.64	0.00	0.01	0.000	0.000	0.000	-29.15	0.17	0.000	28.39
77.00	-0.1	-0.5	-0.8	2.66	0.00	0.01	0.000	0.000	0.000	-28.99	0.17	0.000	28.19
78.00	-0.1	-0.5	-0.8	2.69	0.00	0.01	0.000	0.000	0.000	-28.82	0.17	0.000	27.97
79.00	-0.1	-0.5	-0.8	2.70	0.00	0.01	0.000	0.000	0.000	-28.65	0.17	0.000	27.81
80.00	-0.1	-0.5	-0.8	2.69	0.00	0.01	0.000	0.000	0.000	-28.49	0.17	0.000	27.70
81.00	-0.1	-0.5	-0.8	2.70	0.00	0.01	0.000	0.000	0.000	-28.32	0.17	0.000	27.55
82.00	-0.1	-0.5	-0.8	2.73	0.00	0.01	0.000	0.000	0.000	-28.16	0.17	0.000	27.33
83.00	-0.1	-0.5	-0.8	2.76	0.00	0.01	0.000	0.000	0.000	-27.99	0.17	0.000	27.12
84.00	-0.1	-0.5	-0.8	2.77	0.00	0.01	0.000	0.000	0.000	-27.82	0.17	0.000	26.97
85.00	-0.1	-0.5	-0.8	2.76	0.00	0.01	0.000	0.000	0.000	-27.66	0.17	0.000	26.85
86.00	-0.1	-0.5	-0.8	2.77	0.00	0.01	0.000	0.000	0.000	-27.49	0.17	0.000	26.69
87.00	-0.1	-0.5	-0.8	2.80	0.00	0.01	0.000	0.000	0.000	-27.33	0.17	0.000	26.47
88.00	-0.1	-0.5	-0.8	2.83	0.00	0.01	0.000	0.000	0.000	-27.16	0.17	0.000	26.27
89.00	-0.1	-0.5	-0.8	2.83	0.00	0.01	0.000	0.000	0.000	-26.99	0.17	0.000	26.13
90.00	-0.1	-0.5	-0.8	2.82	0.00	0.01	0.000	0.000	0.000	-26.83	0.17	0.000	26.01
91.00	-0.1	-0.5	-0.8	2.84	0.00	0.01	0.000	0.000	0.000	-26.66	0.17	0.000	25.83
92.00	-0.2	-0.5	-0.8	2.87	0.00	0.01	0.000	0.000	0.000	-26.50	0.17	0.000	25.60
93.00	-0.2	-0.5	-0.8	2.90	0.00	0.01	0.000	0.000	0.000	-26.33	0.17	0.000	25.41
94.00	-0.2	-0.5	-0.8	2.89	0.00	0.01	0.000	0.000	0.000	-26.16	0.17	0.000	25.29
95.00	-0.2	-0.5	-0.8	2.88	0.00	0.01	0.000	0.000	0.000	-26.00	0.17	0.000	25.17

PHASE 1 MOTION

TIME (SECS)	BARGE/LAUNCH COORDINATE SYSTEM **** COORDINATES **** X M	Y M	Z M	****** ANGLES ****** PITCH DEG	ROLL DEG	YAW DEG	*** ACCELERATIONS *** X G'S	Y G'S	Z G'S	RELATIVE JACKET MOTION * ROCKER ARM COORD. SYS. DISPL. M	VEL. M/SEC	ACCEL. G'S	DISTANCE TO BEGIN TIPPING (ESTIMATED) M
96.00	-0.2	-0.5	-0.8	2.91	0.00	0.01	0.000	0.000	0.000	-25.83	0.17	0.000	24.98
97.00	-0.2	-0.5	-0.8	2.94	0.00	0.01	0.000	0.000	0.000	-25.67	0.17	0.000	24.75
98.00	-0.2	-0.5	-0.8	2.96	0.00	0.01	0.000	0.000	0.000	-25.50	0.17	0.000	24.57
99.00	-0.2	-0.5	-0.8	2.96	0.00	0.01	0.000	0.000	0.000	-25.33	0.17	0.000	24.45
100.00	-0.2	-0.5	-0.8	2.95	0.00	0.01	0.000	0.000	0.000	-25.17	0.17	0.000	24.32
101.00	-0.2	-0.5	-0.8	2.98	0.00	0.01	0.000	0.000	0.000	-25.00	0.17	0.000	24.12
102.00	-0.2	-0.5	-0.8	3.01	0.00	0.01	0.000	0.000	0.000	-24.84	0.17	0.000	23.89
103.00	-0.2	-0.5	-0.8	3.02	0.00	0.01	0.000	0.000	0.000	-24.67	0.17	0.000	23.72
104.00	-0.2	-0.5	-0.8	3.02	0.00	0.01	0.000	0.000	0.000	-24.50	0.17	0.000	23.61
105.00	-0.2	-0.5	-0.8	3.02	0.00	0.01	0.000	0.000	0.000	-24.34	0.17	0.000	23.47
106.00	-0.2	-0.5	-0.8	3.05	0.00	0.01	0.000	0.000	0.000	-24.17	0.17	0.000	23.26
107.00	-0.2	-0.5	-0.8	3.08	0.00	0.01	0.000	0.000	0.000	-24.01	0.17	0.000	23.03
108.00	-0.2	-0.5	-0.8	3.09	0.00	0.01	0.000	0.000	0.000	-23.84	0.17	0.000	22.88
109.00	-0.2	-0.5	-0.8	3.08	0.00	0.01	0.000	0.000	0.000	-23.67	0.17	0.000	22.77
110.00	-0.2	-0.5	-0.8	3.08	0.00	0.01	0.000	0.000	0.000	-23.51	0.17	0.000	22.62
111.00	-0.2	-0.5	-0.8	3.12	0.00	0.01	0.000	0.000	0.000	-23.34	0.17	0.000	22.40
112.00	-0.2	-0.5	-0.8	3.15	0.00	0.01	0.000	0.000	0.000	-23.18	0.17	0.000	22.18
113.00	-0.2	-0.5	-0.8	3.16	0.00	0.01	0.000	0.000	0.000	-23.01	0.17	0.000	22.03
114.00	-0.2	-0.5	-0.8	3.15	0.00	0.01	0.000	0.000	0.000	-22.84	0.17	0.000	21.92
115.00	-0.2	-0.5	-0.8	3.15	0.00	0.01	0.000	0.000	0.000	-22.68	0.17	0.000	21.77
116.00	-0.2	-0.5	-0.8	3.19	0.00	0.01	0.000	0.000	0.000	-22.51	0.17	0.000	21.55
117.00	-0.2	-0.5	-0.8	3.22	0.00	0.01	0.000	0.000	0.000	-22.35	0.17	0.000	21.33
118.00	-0.2	-0.5	-0.8	3.22	0.00	0.01	0.000	0.000	0.000	-22.18	0.17	0.000	21.19
119.00	-0.2	-0.5	-0.9	3.21	0.00	0.01	0.000	0.000	0.000	-22.01	0.17	0.000	21.08
120.00	-0.2	-0.5	-0.9	3.22	0.00	0.01	0.000	0.000	0.000	-21.85	0.17	0.000	20.91
121.00	-0.2	-0.5	-0.9	3.26	0.00	0.01	0.000	0.000	0.000	-21.68	0.17	0.000	20.69
122.00	-0.2	-0.5	-0.9	3.29	0.00	0.01	0.000	0.000	0.000	-21.52	0.17	0.000	20.47
123.00	-0.2	-0.5	-0.9	3.29	0.00	0.01	0.000	0.000	0.000	-21.35	0.17	0.000	20.34
124.00	-0.2	-0.5	-0.9	3.28	0.00	0.01	0.000	0.000	0.000	-21.18	0.17	0.000	20.23
125.00	-0.2	-0.5	-0.9	3.29	0.00	0.01	0.000	0.000	0.000	-21.02	0.17	0.000	20.07
126.00	-0.2	-0.5	-0.9	3.33	0.00	0.01	0.000	0.000	0.000	-20.85	0.17	0.000	19.84
127.00	-0.2	-0.5	-0.9	3.36	0.00	0.01	0.000	0.000	0.000	-20.69	0.17	0.000	19.62
128.00	-0.2	-0.5	-0.9	3.36	0.00	0.01	0.000	0.000	0.000	-20.52	0.17	0.000	19.48
129.00	-0.2	-0.5	-0.9	3.35	0.00	0.01	0.000	0.000	0.000	-20.35	0.17	0.000	19.38
130.00	-0.2	-0.5	-0.9	3.36	0.00	0.01	0.000	0.000	0.000	-20.19	0.17	0.000	19.21
131.00	-0.2	-0.5	-0.9	3.40	0.00	0.01	0.000	0.000	0.000	-20.02	0.17	0.000	18.98
131.35	-0.2	-0.5	-0.9	3.41	0.00	0.01	0.000	0.000	0.000	-19.96	0.17	0.000	18.90

PHASE 2 MOTION

TIME (SECS)	BARGE/LAUNCH COORDINATE SYSTEM **** COORDINATES **** X M	Y M	Z M	****** ANGLES ****** PITCH DEG	ROLL DEG	YAW DEG	*** ACCELERATIONS *** X G'S	Y G'S	Z G'S	RELATIVE JACKET MOTION * ROCKER ARM COORD. SYS. DISPL. M	VEL. M/SEC	ACCEL. G'S	DISTANCE TO BEGIN TIPPING (ESTIMATED) M
131.35	-0.2	-0.5	-0.9	3.41	0.00	0.01	0.000	0.000	0.000	-19.96	0.17	0.000	18.90
132.00	-0.2	-0.5	-0.9	3.42	0.00	0.01	0.000	0.000	0.000	-19.86	0.17	0.000	18.78
133.00	-0.2	-0.5	-0.9	3.42	0.00	0.01	0.000	0.000	0.000	-19.68	0.17	0.000	18.64
134.00	-0.2	-0.5	-0.9	3.41	0.00	0.01	0.000	0.000	0.000	-19.51	0.17	0.000	18.51
135.00	-0.2	-0.5	-0.9	3.43	0.00	0.01	0.000	0.000	0.000	-19.35	0.16	0.000	18.34
136.00	-0.2	-0.5	-0.9	3.47	0.00	0.01	0.000	0.000	0.000	-19.18	0.17	0.000	18.13
137.00	-0.2	-0.5	-0.9	3.49	0.00	0.01	0.000	0.000	0.000	-19.00	0.19	0.001	17.93
138.00	-0.2	-0.5	-0.9	3.49	0.00	0.01	0.000	0.000	0.000	-18.79	0.22	0.000	17.76
139.00	-0.3	-0.5	-0.9	3.48	0.00	0.01	0.000	0.000	0.000	-18.57	0.22	0.000	17.57
140.00	-0.3	-0.5	-0.9	3.51	0.00	0.01	0.000	0.000	0.000	-18.35	0.23	0.000	17.33
141.00	-0.3	-0.5	-0.9	3.56	0.00	0.02	0.000	0.000	0.000	-18.11	0.25	0.001	17.05
142.00	-0.4	-0.5	-0.9	3.59	0.00	0.02	0.000	0.000	0.000	-17.83	0.30	0.002	16.77
143.00	-0.4	-0.5	-0.9	3.59	0.00	0.02	0.000	0.000	0.000	-17.51	0.35	0.001	16.48
144.00	-0.5	-0.5	-0.9	3.60	0.00	0.02	-0.001	0.000	0.000	-17.14	0.38	0.001	16.14
145.00	-0.6	-0.5	-0.9	3.64	0.00	0.03	-0.001	0.000	0.000	-16.75	0.42	0.002	15.72
146.00	-0.7	-0.5	-0.9	3.70	0.00	0.03	-0.001	0.000	0.000	-16.30	0.48	0.002	15.24
147.00	-0.8	-0.5	-0.9	3.74	0.00	0.04	-0.001	0.000	0.000	-15.77	0.57	0.003	14.72
148.00	-1.0	-0.5	-0.9	3.77	0.00	0.04	-0.001	0.000	0.000	-15.16	0.65	0.003	14.15
149.00	-1.2	-0.5	-0.9	3.81	0.00	0.05	-0.001	0.000	0.000	-14.47	0.73	0.003	13.49
150.00	-1.4	-0.5	-0.9	3.89	0.00	0.06	-0.001	0.000	0.000	-13.69	0.84	0.004	12.70
151.00	-1.7	-0.5	-0.9	3.98	0.00	0.07	-0.001	0.000	0.000	-12.79	0.97	0.005	11.81
152.00	-2.0	-0.5	-0.9	4.05	0.00	0.08	-0.002	0.000	0.000	-11.74	1.13	0.005	10.83
153.00	-2.3	-0.5	-0.9	4.11	0.00	0.10	-0.002	0.000	0.000	-10.53	1.29	0.005	9.72
154.00	-2.8	-0.5	-0.9	4.20	-0.01	0.12	-0.002	0.000	0.000	-9.16	1.46	0.006	8.46
155.00	-3.3	-0.5	-0.9	4.34	-0.01	0.13	-0.002	0.000	0.000	-7.60	1.67	0.007	7.02
156.00	-3.8	-0.5	-0.9	4.49	-0.01	0.16	-0.003	0.000	0.000	-5.81	1.91	0.008	5.39
157.00	-4.5	-0.5	-0.9	4.64	-0.01	0.18	-0.003	0.000	0.000	-3.76	2.20	0.009	3.53
158.00	-5.3	-0.5	-0.9	4.81	-0.01	0.21	-0.003	0.000	0.000	-1.41	2.51	0.010	1.39
158.58	-5.8	-0.5	-0.9	4.92	-0.01	0.23	-0.004	0.000	0.000	0.10	2.70	0.011	0.00

PHASE 4 MOTION

TIME (SEC)	BARGE/LAUNCH COORDINATE SYSTEM DISPLACEMENTS X M	Y M	Z M	ANGLES PITCH DEG	ROLL DEG	YAW DEG	JACKET BARGE/LAUNCH COORDINATE SYSTEM DISPLACEMENTS X M	Y M	Z M	ANGLES PITCH DEG	ROLL DEG	YAW DEG	SKID MOTION ROCKER ARM CS DISP M	VEL M/SEC	ANGLE DEG	* ROCKER PIN * LOAD KN
158.58	-5.8	-0.5	-0.9	4.92	-0.01	0.23	39.5	1.0	16.7	4.92	-0.01	0.23	0.1	2.70	0.00	43797.7
159.00	-6.1	-0.6	-0.9	5.02	-0.01	0.24	40.3	1.0	16.5	5.05	-0.01	0.24	1.3	2.79	0.03	43769.8
160.00	-7.2	-0.6	-0.9	5.14	0.00	0.27	42.5	1.0	16.1	6.38	-0.01	0.27	4.0	2.70	1.24	42248.6
161.00	-8.4	-0.6	-0.8	4.72	0.02	0.31	45.1	1.0	15.5	10.30	-0.01	0.32	6.8	3.11	5.57	36908.4
162.00	-10.2	-0.6	-0.6	3.46	0.07	0.36	48.6	1.1	14.5	16.36	-0.01	0.37	10.7	4.83	12.90	26448.2
163.00	-12.6	-0.6	-0.1	1.86	0.19	0.41	53.2	1.1	12.0	22.97	0.03	0.44	16.8	7.45	21.11	15157.8
164.00	-15.6	-0.7	0.6	1.05	0.41	0.44	58.3	1.2	7.8	27.31	0.19	0.49	25.2	9.08	26.26	9977.4
164.18	-16.2	-0.7	0.7	1.04	0.45	0.44	59.2	1.2	6.9	27.75	0.22	0.50	26.9	9.16	26.71	9133.9

P H A S E 5 M O T I O N

TIME	BARGE/LAUNCH COORDINATE SYSTEM DISPLACEMENTS X	Y	Z	***** ANGLES ***** PITCH	ROLL	YAW	JACKET DISPLACEMENTS X	Y	Z	BARGE/LAUNCH COORDINATE SYSTEM ***** ANGLES ***** PITCH	ROLL	YAW	* ACCELERATIONS * X	Y	Z	MINIMUM DISTANCE FROM BOTTOM
(SECS)	M	M	M	DEG	DEG	DEG	M	M	M	DEG	DEG	DEG	G'S	G'S	G'S	M
164.18	-16.2	-0.7	0.7	1.0	0.4	0.4	59.2	1.2	6.9	27.8	0.2	0.5	-0.044	-0.001	-0.069	27.98
165.00	-18.9	-0.7	1.2	1.0	0.7	0.5	62.8	1.2	2.3	27.6	0.3	0.5	-0.047	0.001	0.014	23.46
166.00	-22.0	-0.8	1.3	0.6	0.7	0.5	65.8	1.3	-2.9	25.2	0.2	0.5	-0.031	-0.001	0.033	19.50
167.00	-25.1	-0.9	1.0	0.6	0.4	0.5	67.8	1.3	-7.1	22.8	0.0	0.4	-0.020	0.000	0.021	16.66
168.00	-28.2	-1.0	0.4	1.1	0.7	0.5	69.1	1.3	-10.7	20.2	-0.1	0.4	-0.013	0.000	0.015	14.63
169.00	-31.1	-1.1	0.1	1.4	1.0	0.5	70.0	1.4	-13.8	17.3	-0.4	0.4	-0.009	0.000	0.013	13.10
170.00	-34.1	-1.2	0.3	1.2	0.7	0.6	70.7	1.4	-16.4	14.1	-0.6	0.4	-0.006	0.000	0.015	12.27
171.00	-37.0	-1.2	0.8	0.7	0.6	0.6	71.1	1.4	-18.5	10.5	-0.9	0.4	-0.005	0.000	0.018	12.23
172.00	-39.8	-1.2	1.2	0.6	0.7	0.7	71.4	1.4	-20.0	6.8	-1.1	0.4	-0.003	0.000	0.020	13.00
173.00	-42.6	-1.3	1.2	0.9	0.6	0.7	71.6	1.4	-20.9	3.0	-1.4	0.4	-0.003	0.000	0.021	14.52
174.00	-45.3	-1.4	0.8	0.9	0.5	0.7	71.7	1.4	-21.2	-0.5	-1.6	0.4	-0.002	0.000	0.019	15.77
175.00	-48.0	-1.5	0.3	1.0	0.9	0.8	71.7	1.5	-20.8	-3.5	-1.8	0.3	-0.001	0.000	0.017	14.61
176.00	-50.6	-1.5	0.1	1.1	0.9	0.8	71.7	1.5	-19.8	-5.9	-2.0	0.3	0.000	0.000	0.013	14.34
177.00	-53.2	-1.6	0.4	1.2	0.6	0.8	71.7	1.5	-18.5	-7.7	-2.1	0.2	0.000	0.000	0.007	14.83
178.00	-55.8	-1.6	0.9	0.9	0.6	0.8	71.7	1.6	-16.9	-9.0	-2.2	0.2	0.000	0.000	-0.002	15.77
179.00	-58.3	-1.6	1.2	0.6	0.7	0.9	71.7	1.6	-15.4	-10.6	-2.2	0.1	0.000	0.000	-0.012	16.59
180.00	-60.7	-1.7	1.1	0.7	0.5	0.9	71.7	1.6	-14.3	-12.7	-2.2	0.1	0.000	-0.001	-0.019	16.84
181.00	-63.1	-1.8	0.6	1.1	0.6	0.9	71.7	1.6	-13.8	-15.4	-2.0	0.0	-0.001	-0.001	-0.020	16.41
182.00	-65.5	-1.8	0.2	1.2	0.9	1.0	71.7	1.6	-13.9	-17.9	-1.7	0.0	-0.001	0.000	-0.013	15.58
183.00	-67.9	-1.9	0.2	1.1	0.8	1.0	71.6	1.5	-14.5	-19.3	-1.1	0.0	0.000	0.000	-0.002	14.84
184.00	-70.2	-1.9	0.6	0.9	0.6	1.0	71.5	1.5	-15.1	-19.4	-0.5	0.0	0.001	0.000	0.008	14.64
185.00	-72.5	-1.9	1.0	0.8	0.6	1.1	71.4	1.5	-15.4	-18.1	0.0	0.0	0.001	0.000	0.014	15.04
186.00	-74.8	-1.9	1.2	0.8	0.6	1.1	71.4	1.4	-15.4	-16.3	0.4	0.0	0.001	0.000	0.009	15.52
187.00	-77.0	-2.0	1.0	0.8	0.5	1.1	71.4	1.4	-15.1	-14.6	0.5	-0.1	0.000	0.000	-0.001	16.42
188.00	-79.1	-2.0	0.5	0.9	0.7	1.1	71.4	1.4	-14.8	-13.5	0.5	-0.1	0.000	0.000	-0.006	17.19
189.00	-81.3	-2.1	0.2	1.2	0.8	1.2	71.4	1.4	-14.7	-13.3	0.3	-0.1	0.000	0.000	-0.007	17.51
190.00	-83.4	-2.1	0.3	1.2	0.7	1.2	71.4	1.4	-14.7	-14.1	-0.1	-0.1	0.000	0.000	-0.005	17.28
191.00	-85.5	-2.1	0.7	0.9	0.6	1.2	71.3	1.4	-15.0	-15.5	-0.5	-0.1	0.000	0.000	0.002	16.21
192.00	-87.6	-2.1	1.1	0.7	0.6	1.3	71.3	1.4	-15.1	-17.0	-1.0	-0.1	0.001	0.000	0.008	15.16
193.00	-89.6	-2.1	1.1	0.7	0.6	1.3	71.3	1.5	-15.1	-18.0	-1.4	-0.1	0.000	0.000	0.006	14.57
194.00	-91.6	-2.1	0.8	1.0	0.6	1.3	71.3	1.5	-14.8	-18.1	-1.7	-0.2	0.000	0.000	0.002	14.62
195.00	-93.6	-2.2	0.4	1.1	0.8	1.4	71.3	1.5	-14.5	-17.4	-1.7	-0.2	0.000	0.000	-0.005	15.20
196.00	-95.6	-2.2	0.2	1.1	0.8	1.4	71.3	1.5	-14.3	-16.2	-1.5	-0.3	-0.001	0.000	-0.008	15.92
197.00	-97.5	-2.2	0.5	1.1	0.7	1.4	71.3	1.4	-14.4	-15.2	-1.4	-0.3	0.000	0.000	-0.007	16.34
198.00	-99.5	-2.2	0.9	0.9	0.6	1.5	71.3	1.4	-14.7	-14.8	-1.2	-0.3	0.000	0.000	-0.003	16.27
199.00	-101.4	-2.2	1.1	0.7	0.6	1.5	71.3	1.4	-15.1	-15.0	-1.1	-0.4	0.000	0.000	0.004	15.83
200.00	-103.2	-2.2	1.0	0.7	0.6	1.5	71.2	1.4	-15.4	-15.5	-1.2	-0.4	0.001	0.000	0.009	15.36
201.00	-105.1	-2.2	0.7	0.9	0.7	1.5	71.2	1.4	-15.4	-15.9	-1.2	-0.4	0.001	0.000	0.010	15.17
202.00	-106.9	-2.2	0.3	1.2	0.8	1.6	71.2	1.4	-15.1	-16.2	-1.2	-0.4	0.000	0.000	0.005	15.36
203.00	-108.7	-2.3	0.3	1.1	0.7	1.6	71.3	1.4	-14.7	-16.3	-1.3	-0.5	0.000	0.000	-0.003	15.73
204.00	-110.5	-2.2	0.6	0.9	0.7	1.6	71.3	1.4	-14.3	-16.5	-1.3	-0.5	-0.001	0.000	-0.009	16.02
205.00	-112.3	-2.2	1.0	0.8	0.6	1.7	71.3	1.4	-14.2	-16.7	-1.3	-0.5	-0.001	0.000	-0.011	16.06
206.00	-114.1	-2.2	1.1	0.8	0.6	1.7	71.3	1.4	-14.4	-16.8	-1.3	-0.5	0.000	0.000	-0.006	15.86
207.00	-115.8	-2.2	0.9	0.9	0.6	1.7	71.3	1.4	-14.8	-16.7	-1.2	-0.5	0.000	0.000	0.002	15.55
208.00	-117.5	-2.2	0.6	1.0	0.7	1.8	71.2	1.3	-15.1	-16.5	-1.1	-0.6	0.000	0.000	0.007	15.36
209.00	-119.1	-2.2	0.3	1.1	0.8	1.8	71.2	1.3	-15.2	-16.2	-1.0	-0.6	0.001	0.000	0.008	15.43
210.00	-120.8	-2.2	0.4	1.1	0.7	1.8	71.2	1.3	-15.1	-15.7	-1.0	-0.6	0.000	0.000	0.004	15.73
211.00	-122.5	-2.2	0.7	1.0	0.6	1.9	71.2	1.3	-14.9	-15.4	-1.0	-0.6	0.000	0.000	-0.001	16.08

P H A S E 5 M O T I O N

TIME	BARGE/LAUNCH COORDINATE SYSTEM DISPLACEMENTS X	Y	Z	***** ANGLES ***** PITCH	ROLL	YAW	JACKET DISPLACEMENTS X	Y	Z	BARGE/LAUNCH COORDINATE SYSTEM ***** ANGLES ***** PITCH	ROLL	YAW	* ACCELERATIONS * X	Y	Z	MINIMUM DISTANCE FROM BOTTOM
(SECS)	M	M	M	DEG	DEG	DEG	M	M	M	DEG	DEG	DEG	G'S	G'S	G'S	M
212.00	-124.2	-2.2	1.0	0.7	0.6	1.9	71.2	1.3	-14.7	-15.4	-1.2	-0.6	0.000	0.000	-0.004	16.21
213.00	-125.8	-2.2	1.1	0.7	0.6	1.9	71.2	1.3	-14.6	-15.8	-1.4	-0.6	0.000	0.000	-0.004	16.01
214.00	-127.4	-2.2	0.8	0.9	0.6	1.9	71.2	1.3	-14.6	-16.5	-1.6	-0.6	0.000	0.000	-0.003	15.56
215.00	-129.0	-2.2	0.5	1.1	0.7	2.0	71.2	1.3	-14.7	-17.1	-1.8	-0.7	0.000	0.000	0.000	15.11
216.00	-130.5	-2.2	0.3	1.1	0.8	2.0	71.2	1.3	-14.8	-17.3	-1.8	-0.7	0.000	0.000	0.002	14.95
217.00	-132.1	-2.1	0.5	1.0	0.7	2.0	71.2	1.3	-14.8	-16.9	-1.7	-0.7	0.000	0.000	0.002	15.15
218.00	-133.7	-2.1	0.8	0.9	0.6	2.1	71.2	1.3	-14.8	-16.2	-1.4	-0.7	0.000	0.000	0.000	15.61
219.00	-135.2	-2.1	1.1	0.8	0.6	2.1	71.2	1.3	-14.7	-15.6	-1.2	-0.7	0.000	0.000	-0.002	16.04
220.00	-136.7	-2.1	1.0	0.8	0.6	2.1	71.2	1.3	-14.8	-15.3	-1.1	-0.8	0.000	0.000	-0.003	16.22
221.00	-138.2	-2.1	0.7	0.9	0.6	2.2	71.2	1.3	-14.8	-15.5	-1.1	-0.8	0.000	0.000	-0.001	16.10
222.00	-139.7	-2.1	0.4	1.1	0.7	2.2	71.2	1.2	-14.9	-15.9	-1.1	-0.8	0.000	0.000	0.002	15.78
223.00	-141.1	-2.0	0.4	1.1	0.7	2.2	71.2	1.2	-15.0	-16.5	-1.2	-0.8	0.000	0.000	0.004	15.45
224.00	-142.6	-2.0	0.6	1.0	0.7	2.2	71.2	1.2	-14.9	-16.9	-1.4	-0.8	0.000	0.000	0.003	15.30
225.00	-144.1	-2.0	0.9	0.8	0.6	2.3	71.2	1.2	-14.7	-17.0	-1.5	-0.8	0.000	0.000	0.000	15.40
226.00	-145.5	-1.9	1.1	0.8	0.6	2.3	71.2	1.2	-14.5	-16.8	-1.5	-0.9	0.000	0.000	-0.004	15.65
227.00	-146.9	-1.9	0.9	0.9	0.6	2.3	71.2	1.2	-14.5	-16.4	-1.5	-0.9	0.000	0.000	-0.005	15.88
228.00	-148.3	-1.9	0.6	1.0	0.7	2.4	71.2	1.2	-14.6	-16.1	-1.4	-0.9	0.000	0.000	-0.004	15.94
229.00	-149.7	-1.9	0.4	1.1	0.7	2.4	71.2	1.2	-14.8	-16.0	-1.4	-0.9	0.000	0.000	0.000	15.79
230.00	-151.1	-1.8	0.4	1.1	0.7	2.4	71.2	1.2	-15.0	-16.0	-1.4	-0.9	0.000	0.000	0.003	15.55
231.00	-152.5	-1.8	0.7	1.0	0.6	2.4	71.2	1.2	-15.1	-16.1	-1.4	-0.9	0.000	0.000	0.005	15.37
232.00	-153.9	-1.8	1.0	0.8	0.6	2.5	71.2	1.2	-15.1	-16.1	-1.5	-1.0	0.000	0.000	0.005	15.38
233.00	-155.2	-1.7	1.0	0.8	0.6	2.5	71.2	1.2	-14.9	-16.1	-1.6	-1.0	0.000	0.000	0.001	15.54
234.00	-156.6	-1.7	0.8	0.9	0.6	2.5	71.2	1.2	-14.6	-16.1	-1.6	-1.0	0.000	0.000	-0.003	15.71
235.00	-157.9	-1.7	0.5	1.1	0.7	2.6	71.2	1.2	-14.5	-16.3	-1.7	-1.0	0.000	0.000	-0.005	15.76
236.00	-159.2	-1.6	0.4	1.1	0.7	2.6	71.2	1.2	-14.5	-16.5	-1.7	-1.0	0.000	0.000	-0.004	15.66
237.00	-160.5	-1.6	0.5	1.0	0.7	2.6	71.2	1.2	-14.7	-16.7	-1.7	-1.0	0.000	0.000	-0.001	15.48
238.00	-161.8	-1.5	0.8	0.9	0.6	2.6	71.2	1.2	-14.8	-16.7	-1.6	-1.0	0.000	0.000	0.002	15.36
239.00	-163.1	-1.5	1.0	0.8	0.6	2.7	71.2	1.2	-15.0	-16.5	-1.4	-1.1	0.000	0.000	0.004	15.41
240.00	-164.4	-1.5	1.0	0.8	0.6	2.7	71.2	1.1	-15.0	-16.2	-1.3	-1.1	0.000	0.000	0.003	15.62
241.00	-165.6	-1.4	0.7	0.9	0.6	2.7	71.2	1.1	-14.9	-15.9	-1.2	-1.1	0.000	0.000	0.001	15.89
242.00	-166.9	-1.4	0.5	1.0	0.7	2.8	71.2	1.1	-14.7	-15.8	-1.2	-1.1	0.000	0.000	-0.001	16.06
243.00	-168.1	-1.4	0.4	1.1	0.7	2.8	71.2	1.1	-14.7	-16.0	-1.2	-1.1	0.000	0.000	-0.002	16.02
244.00	-169.4	-1.3	0.6	1.0	0.7	2.8	71.2	1.1	-14.7	-16.3	-1.4	-1.1	0.000	0.000	-0.001	15.80
245.00	-170.6	-1.3	0.9	0.9	0.6	2.8	71.2	1.1	-14.7	-16.8	-1.5	-1.1	0.000	0.000	0.000	15.51
246.00	-171.8	-1.2	1.0	0.8	0.6	2.9	71.2	1.1	-14.8	-17.0	-1.6	-1.1	0.000	0.000	0.001	15.31
247.00	-173.0	-1.2	0.9	0.9	0.6	2.9	71.2	1.1	-14.8	-16.9	-1.6	-1.2	0.000	0.000	0.001	15.32
248.00	-174.2	-1.1	0.6	1.0	0.7	2.9	71.2	1.1	-14.8	-16.5	-1.6	-1.2	0.000	0.000	0.000	15.52
249.00	-175.4	-1.1	0.4	1.1	0.7	2.9	71.2	1.1	-14.7	-16.0	-1.5	-1.2	0.000	0.000	-0.001	15.76
250.00	-176.6	-1.1	0.4	1.1	0.7	3.0	71.2	1.1	-14.7	-15.7	-1.5	-1.2	0.000	0.000	-0.002	15.88
251.00	-177.8	-1.0	0.7	1.0	0.6	3.0	71.2	1.1	-14.8	-15.7	-1.5	-1.2	0.000	0.000	-0.001	15.82
252.00	-179.0	-0.9	0.9	0.9	0.6	3.0	71.2	1.1	-14.9	-15.9	-1.6	-1.2	0.000	0.000	0.001	15.62
253.00	-180.1	-0.9	1.0	0.8	0.6	3.0	71.2	1.1	-14.9	-16.2	-1.7	-1.2	0.000	0.000	0.003	15.40
254.00	-181.3	-0.9	0.8	0.9	0.6	3.1	71.2	1.1	-14.9	-16.5	-1.8	-1.2	0.000	0.000	0.003	15.29
255.00	-182.4	-0.8	0.6	1.0	0.7	3.1	71.2	1.1	-14.8	-16.6	-1.8	-1.3	0.000	0.000	0.001	15.35
256.00	-183.5	-0.8	0.4	1.1	0.7	3.1	71.2	1.1	-14.6	-16.5	-1.7	-1.3	0.000	0.000	-0.002	15.53
257.00	-184.7	-0.7	0.5	1.1	0.7	3.2	71.2	1.1	-14.6	-16.4	-1.7	-1.3	0.000	0.000	-0.004	15.72
258.00	-185.8	-0.7	0.8	0.9	0.6	3.2	71.2	1.1	-14.6	-16.3	-1.5	-1.3	0.000	0.000	-0.003	15.81
259.00	-186.9	-0.6	1.0	0.8	0.6	3.2	71.2	1.0	-14.7	-16.2	-1.4	-1.3	0.000	0.000	-0.001	15.77

P H A S E 5 M O T I O N

TIME	BARGE DISPLACEMENTS X	Y	Z	BARGE ANGLES PITCH	ROLL	YAW	JACKET DISPLACEMENTS X	Y	Z	JACKET ANGLES PITCH	ROLL	YAW	ACCELERATIONS X	Y	Z	MINIMUM DISTANCE FROM BOTTOM
(SECS)	M	M	M	DEG	DEG	DEG	M	M	M	DEG	DEG	DEG	G'S	G'S	G'S	M
260.00	-188.0	-0.5	1.0	0.8	0.6	3.2	71.2	1.0	-14.9	-16.3	-1.4	-1.3	0.000	0.000	0.002	15.66
261.00	-189.1	-0.5	0.7	0.9	0.6	3.3	71.2	1.0	-15.0	-16.3	-1.3	-1.3	0.000	0.000	0.003	15.58
262.00	-190.2	-0.5	0.5	1.0	0.7	3.3	71.2	1.0	-14.9	-16.4	-1.3	-1.3	0.000	0.000	0.003	15.60
263.00	-191.3	-0.4	0.4	1.1	0.7	3.3	71.2	1.0	-14.8	-16.3	-1.4	-1.4	0.000	0.000	0.001	15.70
264.00	-192.3	-0.3	0.6	1.0	0.7	3.3	71.2	1.0	-14.7	-16.3	-1.4	-1.4	0.000	0.000	-0.002	15.80
265.00	-193.4	-0.3	0.8	0.9	0.6	3.4	71.2	1.0	-14.6	-16.4	-1.5	-1.4	0.000	0.000	-0.003	15.82
266.00	-194.5	-0.2	1.0	0.8	0.6	3.4	71.2	1.0	-14.6	-16.5	-1.6	-1.4	0.000	0.000	-0.003	15.73
267.00	-195.5	-0.2	0.9	0.8	0.6	3.4	71.2	1.0	-14.7	-16.6	-1.7	-1.4	0.000	0.000	-0.001	15.56
268.00	-196.6	-0.1	0.7	1.0	0.6	3.4	71.2	1.0	-14.8	-16.5	-1.7	-1.4	0.000	0.000	0.001	15.41
269.00	-197.6	-0.1	0.5	1.1	0.7	3.4	71.2	1.0	-14.9	-16.4	-1.7	-1.4	0.000	0.000	0.003	15.38
270.00	-198.6	0.0	0.5	1.1	0.7	3.5	71.2	1.0	-14.9	-16.2	-1.7	-1.4	0.000	0.000	0.002	15.47
271.00	-199.7	0.0	0.6	1.0	0.6	3.5	71.2	1.0	-14.9	-15.9	-1.6	-1.4	0.000	0.000	0.001	15.64
272.00	-200.7	0.1	0.9	0.9	0.6	3.5	71.2	1.0	-14.8	-15.8	-1.6	-1.5	0.000	0.000	-0.001	15.76
273.00	-201.7	0.2	1.0	0.8	0.6	3.5	71.2	1.0	-14.7	-15.9	-1.7	-1.5	0.000	0.000	-0.002	15.75
274.00	-202.7	0.2	0.8	0.9	0.6	3.6	71.2	1.0	-14.7	-16.2	-1.7	-1.5	0.000	0.000	-0.001	15.62
275.00	-203.7	0.3	0.6	1.0	0.7	3.6	71.2	1.0	-14.7	-16.5	-1.8	-1.5	0.000	0.000	0.000	15.44
276.00	-204.7	0.3	0.4	1.1	0.7	3.6	71.2	1.0	-14.8	-16.7	-1.8	-1.5	0.000	0.000	0.001	15.34
277.00	-205.7	0.4	0.5	1.1	0.7	3.6	71.2	1.0	-14.8	-16.7	-1.7	-1.5	0.000	0.000	0.001	15.39
278.00	-206.7	0.5	0.7	0.9	0.6	3.7	71.2	1.0	-14.7	-16.5	-1.6	-1.5	0.000	0.000	0.000	15.57
279.00	-207.7	0.5	0.9	0.8	0.6	3.7	71.2	1.0	-14.7	-16.2	-1.5	-1.5	0.000	0.000	-0.001	15.79
280.00	-208.7	0.6	0.9	0.8	0.6	3.7	71.2	0.9	-14.7	-16.0	-1.4	-1.5	0.000	0.000	-0.001	15.92
281.00	-209.6	0.6	0.8	0.9	0.6	3.7	71.2	0.9	-14.8	-16.0	-1.3	-1.5	0.000	0.000	-0.001	15.91
282.00	-210.6	0.7	0.5	1.0	0.7	3.8	71.2	0.9	-14.8	-16.2	-1.4	-1.6	0.000	0.000	0.001	15.78
283.00	-211.5	0.7	0.4	1.1	0.7	3.8	71.2	0.9	-14.8	-16.4	-1.4	-1.6	0.000	0.000	0.002	15.61
284.00	-212.5	0.8	0.6	1.0	0.7	3.8	71.2	0.9	-14.8	-16.6	-1.5	-1.6	0.000	0.000	0.002	15.50
285.00	-213.5	0.9	0.8	0.9	0.6	3.8	71.2	0.9	-14.7	-16.7	-1.6	-1.6	0.000	0.000	0.000	15.50
286.00	-214.4	1.0	0.9	0.8	0.6	3.8	71.2	0.9	-14.7	-16.6	-1.7	-1.6	0.000	0.000	-0.001	15.59
287.00	-215.3	1.0	0.9	0.9	0.6	3.9	71.2	0.9	-14.6	-16.4	-1.7	-1.6	0.000	0.000	-0.002	15.69
288.00	-216.3	1.1	0.7	1.0	0.6	3.9	71.2	0.9	-14.7	-16.2	-1.7	-1.6	0.000	0.000	-0.002	15.72
289.00	-217.2	1.1	0.5	1.1	0.7	3.9	71.2	0.9	-14.7	-16.1	-1.7	-1.6	0.000	0.000	-0.001	15.65
290.00	-218.1	1.2	0.5	1.1	0.7	3.9	71.2	0.9	-14.9	-16.1	-1.7	-1.6	0.000	0.000	0.001	15.53
291.00	-219.0	1.3	0.6	1.0	0.6	3.9	71.2	0.9	-14.9	-16.2	-1.8	-1.6	0.000	0.000	0.003	15.44
292.00	-219.9	1.3	0.9	0.9	0.6	4.0	71.2	0.9	-14.9	-16.2	-1.8	-1.6	0.000	0.000	0.002	15.43
293.00	-220.9	1.4	0.9	0.9	0.6	4.0	71.2	0.9	-14.8	-16.2	-1.8	-1.6	0.000	0.000	0.001	15.51
294.00	-221.7	1.5	0.8	0.9	0.6	4.0	71.2	0.9	-14.7	-16.2	-1.8	-1.7	0.000	0.000	-0.001	15.62
295.00	-222.6	1.5	0.6	1.0	0.6	4.0	71.2	0.9	-14.6	-16.3	-1.8	-1.7	0.000	0.000	-0.002	15.68
296.00	-223.5	1.6	0.5	1.1	0.7	4.1	71.2	0.9	-14.6	-16.4	-1.8	-1.7	0.000	0.000	-0.002	15.66
297.00	-224.4	1.6	0.5	1.1	0.7	4.1	71.2	0.9	-14.7	-16.5	-1.7	-1.7	0.000	0.000	-0.001	15.58
298.00	-225.3	1.7	0.7	1.0	0.6	4.1	71.2	0.9	-14.8	-16.6	-1.6	-1.7	0.000	0.000	0.001	15.52
299.00	-226.2	1.8	0.9	0.9	0.6	4.1	71.2	0.9	-14.8	-16.5	-1.6	-1.7	0.000	0.000	0.002	15.54
300.00	-227.1	1.8	0.9	0.8	0.6	4.1	71.2	0.9	-14.9	-16.3	-1.5	-1.7	0.000	0.000	0.002	15.64

LAUNCH RUNNER REPORT

TIME (SEC)	PHASE	LEFT CONTACT POINT COORD. X M	Y M	Z M	NORMAL FORCE KN	RIGHT CONTACT POINT COORD. X M	Y M	Z M	NORMAL FORCE KN	ROCKER PIN ANGLE DEG	TOTAL NORMAL FORCE KN
0.00	1	8.51	-23.70	0.00	25193.70	-9.49	-23.70	0.00	20843.06	0.00	46036.76
1.00	1	8.51	-23.54	0.00	25189.60	-9.49	-23.54	0.00	20840.45	0.00	46030.05
2.00	1	8.51	-23.37	0.00	25187.21	-9.49	-23.37	0.00	20839.14	0.00	46026.36
3.00	1	8.51	-23.20	0.00	25189.03	-9.49	-23.20	0.00	20840.52	0.00	46029.55
4.00	1	8.51	-23.04	0.00	25194.60	-9.49	-23.04	0.00	20843.62	0.00	46038.22
5.00	1	8.51	-22.87	0.00	25199.35	-9.49	-22.87	0.00	20845.70	0.00	46045.05
6.00	1	8.51	-22.71	0.00	25198.71	-9.49	-22.71	0.00	20844.99	0.00	46043.71
7.00	1	8.51	-22.54	0.00	25193.01	-9.49	-22.54	0.00	20842.32	0.00	46035.32
7.50	1	8.51	-22.46	0.00	25189.72	-9.49	-22.46	0.00	20840.88	0.00	46030.61
8.00	1	8.51	-22.37	0.00	25187.09	-9.49	-22.37	0.00	20839.68	0.00	46026.77
8.50	1	8.51	-22.29	0.00	25185.59	-9.49	-22.29	0.00	20838.82	0.00	46024.41
9.00	1	8.51	-22.21	0.00	25185.41	-9.49	-22.21	0.00	20838.41	0.00	46023.82
9.50	1	8.51	-22.12	0.00	25186.44	-9.49	-22.12	0.00	20838.49	0.00	46024.93
10.00	1	8.51	-22.04	0.00	25188.40	-9.49	-22.04	0.00	20839.10	0.00	46027.50
10.50	1	8.51	-21.96	0.00	25190.88	-9.49	-21.96	0.00	20840.20	0.00	46031.07
11.00	1	8.51	-21.88	0.00	25193.41	-9.49	-21.88	0.00	20841.68	0.00	46035.09
11.50	1	8.51	-21.79	0.00	25195.61	-9.49	-21.79	0.00	20843.26	0.00	46038.88
12.00	1	8.51	-21.71	0.00	25197.13	-9.49	-21.71	0.00	20844.59	0.00	46041.73
12.50	1	8.51	-21.63	0.00	25197.70	-9.49	-21.63	0.00	20845.28	0.00	46042.98
13.00	1	8.51	-21.54	0.00	25197.16	-9.49	-21.54	0.00	20845.04	0.00	46042.20
13.50	1	8.51	-21.46	0.00	25195.52	-9.49	-21.46	0.00	20843.83	0.00	46039.36
14.00	1	8.51	-21.38	0.00	25193.01	-9.49	-21.38	0.00	20841.88	0.00	46034.89
14.50	1	8.51	-21.29	0.00	25190.04	-9.49	-21.29	0.00	20839.67	0.00	46029.70
15.00	1	8.51	-21.21	0.00	25187.17	-9.49	-21.21	0.00	20837.77	0.00	46024.94
15.50	1	8.51	-21.13	0.00	25185.00	-9.49	-21.13	0.00	20836.66	0.00	46021.66
16.00	1	8.51	-21.05	0.00	25183.99	-9.49	-21.05	0.00	20836.61	0.00	46020.60
16.50	1	8.51	-20.96	0.00	25184.37	-9.49	-20.96	0.00	20837.49	0.00	46021.86
17.00	1	8.51	-20.88	0.00	25186.01	-9.49	-20.88	0.00	20838.96	0.00	46024.96
17.50	1	8.51	-20.80	0.00	25188.53	-9.49	-20.80	0.00	20840.50	0.00	46029.03
18.00	1	8.51	-20.71	0.00	25191.35	-9.49	-20.71	0.00	20841.70	0.00	46033.05
18.50	1	8.51	-20.63	0.00	25193.87	-9.49	-20.63	0.00	20842.35	0.00	46036.22
19.00	1	8.51	-20.55	0.00	25195.59	-9.49	-20.55	0.00	20842.50	0.00	46038.09
19.50	1	8.51	-20.46	0.00	25196.29	-9.49	-20.46	0.00	20842.32	0.00	46038.60
20.00	1	8.51	-20.38	0.00	25195.85	-9.49	-20.38	0.00	20842.05	0.00	46037.90
20.50	1	8.51	-20.30	0.00	25194.47	-9.49	-20.30	0.00	20841.78	0.00	46036.25
21.00	1	8.51	-20.22	0.00	25192.36	-9.49	-20.22	0.00	20841.44	0.00	46033.80
21.50	1	8.51	-20.13	0.00	25189.85	-9.49	-20.13	0.00	20840.81	0.00	46030.66
22.00	1	8.51	-20.05	0.00	25187.28	-9.49	-20.05	0.00	20839.71	0.00	46026.99
22.50	1	8.51	-19.97	0.00	25184.97	-9.49	-19.97	0.00	20838.16	0.00	46023.14
23.00	1	8.51	-19.88	0.00	25183.34	-9.49	-19.88	0.00	20836.45	0.00	46019.79
23.50	1	8.51	-19.80	0.00	25182.71	-9.49	-19.80	0.00	20835.11	0.00	46017.82
24.00	1	8.51	-19.72	0.00	25183.35	-9.49	-19.72	0.00	20834.71	0.00	46018.05
24.50	1	8.51	-19.63	0.00	25185.25	-9.49	-19.63	0.00	20835.59	0.00	46020.84
25.00	1	8.51	-19.55	0.00	25188.13	-9.49	-19.55	0.00	20837.71	0.00	46025.83
25.50	1	8.51	-19.47	0.00	25191.41	-9.49	-19.47	0.00	20840.53	0.00	46031.93

LAUNCH RUNNER REPORT

TIME (SEC)	PHASE	LEFT CONTACT POINT COORD. X M	Y M	Z M	NORMAL FORCE KN	RIGHT CONTACT POINT COORD. X M	Y M	Z M	NORMAL FORCE KN	ROCKER PIN ANGLE DEG	TOTAL NORMAL FORCE KN
26.00	1	8.51	-19.39	0.00	25194.33	-9.49	-19.39	0.00	20843.18	0.00	46037.51
26.50	1	8.51	-19.30	0.00	25196.12	-9.49	-19.30	0.00	20844.78	0.00	46040.90
27.00	1	8.51	-19.22	0.00	25196.28	-9.49	-19.22	0.00	20844.72	0.00	46041.00
27.50	1	8.51	-19.14	0.00	25194.66	-9.49	-19.14	0.00	20843.00	0.00	46037.66
28.00	1	8.51	-19.05	0.00	25191.68	-9.49	-19.05	0.00	20840.14	0.00	46031.82
28.50	1	8.51	-18.97	0.00	25188.04	-9.49	-18.97	0.00	20837.08	0.00	46025.13
29.00	1	8.51	-18.89	0.00	25184.68	-9.49	-18.89	0.00	20834.75	0.00	46019.43
29.50	1	8.51	-18.80	0.00	25182.33	-9.49	-18.80	0.00	20833.82	0.00	46016.15
30.00	1	8.51	-18.72	0.00	25181.42	-9.49	-18.72	0.00	20834.34	0.00	46015.76
30.50	1	8.51	-18.64	0.00	25181.94	-9.49	-18.64	0.00	20835.84	0.00	46017.78
31.00	1	8.51	-18.56	0.00	25183.49	-9.49	-18.56	0.00	20837.57	0.00	46021.06
31.50	1	8.51	-18.47	0.00	25185.54	-9.49	-18.47	0.00	20838.79	0.00	46024.33
32.00	1	8.51	-18.39	0.00	25187.58	-9.49	-18.39	0.00	20839.13	0.00	46026.71
32.50	1	8.51	-18.31	0.00	25189.31	-9.49	-18.31	0.00	20838.75	0.00	46028.06
33.00	1	8.51	-18.22	0.00	25190.63	-9.49	-18.22	0.00	20838.15	0.00	46028.78
33.50	1	8.51	-18.14	0.00	25191.58	-9.49	-18.14	0.00	20837.96	0.00	46029.54
34.00	1	8.51	-18.06	0.00	25192.18	-9.49	-18.06	0.00	20838.51	0.00	46030.70
34.50	1	8.51	-17.97	0.00	25192.33	-9.49	-17.97	0.00	20839.69	0.00	46032.02
35.00	1	8.51	-17.89	0.00	25191.80	-9.49	-17.89	0.00	20840.89	0.00	46032.68
35.50	1	8.51	-17.81	0.00	25190.31	-9.49	-17.81	0.00	20841.30	0.00	46031.61
36.00	1	8.51	-17.73	0.00	25187.80	-9.49	-17.73	0.00	20840.34	0.00	46028.14
36.50	1	8.51	-17.64	0.00	25184.55	-9.49	-17.64	0.00	20837.90	0.00	46022.44
37.00	1	8.51	-17.56	0.00	25181.21	-9.49	-17.56	0.00	20834.59	0.00	46015.80
37.50	1	8.51	-17.48	0.00	25178.67	-9.49	-17.48	0.00	20831.52	0.00	46010.20
38.00	1	8.51	-17.39	0.00	25177.80	-9.49	-17.39	0.00	20829.90	0.00	46007.71
38.50	1	8.51	-17.31	0.00	25179.08	-9.49	-17.31	0.00	20830.48	0.00	46009.55
39.00	1	8.51	-17.23	0.00	25182.34	-9.49	-17.23	0.00	20833.24	0.00	46015.58
39.50	1	8.51	-17.14	0.00	25186.76	-9.49	-17.14	0.00	20837.35	0.00	46024.11
40.00	1	8.51	-17.06	0.00	25191.11	-9.49	-17.06	0.00	20841.38	0.00	46032.49
40.50	1	8.51	-16.98	0.00	25194.12	-9.49	-16.98	0.00	20843.90	0.00	46038.02
41.00	1	8.51	-16.90	0.00	25194.93	-9.49	-16.90	0.00	20844.00	0.00	46038.93
41.50	1	8.51	-16.81	0.00	25193.34	-9.49	-16.81	0.00	20841.71	0.00	46035.05
42.00	1	8.51	-16.73	0.00	25189.94	-9.49	-16.73	0.00	20837.89	0.00	46027.83
42.50	1	8.51	-16.65	0.00	25185.82	-9.49	-16.65	0.00	20833.99	0.00	46019.81
43.00	1	8.51	-16.56	0.00	25182.17	-9.49	-16.56	0.00	20831.37	0.00	46013.54
43.50	1	8.51	-16.48	0.00	25179.88	-9.49	-16.48	0.00	20830.79	0.00	46010.67
44.00	1	8.51	-16.40	0.00	25179.25	-9.49	-16.40	0.00	20832.12	0.00	46011.37
44.50	1	8.51	-16.31	0.00	25179.95	-9.49	-16.31	0.00	20834.47	0.00	46014.41
45.00	1	8.51	-16.23	0.00	25181.28	-9.49	-16.23	0.00	20836.57	0.00	46017.85
45.50	1	8.51	-16.15	0.00	25182.56	-9.49	-16.15	0.00	20837.42	0.00	46019.98
46.00	1	8.51	-16.07	0.00	25183.41	-9.49	-16.07	0.00	20836.71	0.00	46020.12
46.50	1	8.51	-15.98	0.00	25183.88	-9.49	-15.98	0.00	20834.96	0.00	46018.85
47.00	1	8.51	-15.90	0.00	25184.42	-9.49	-15.90	0.00	20833.27	0.00	46017.69
47.50	1	8.51	-15.82	0.00	25185.46	-9.49	-15.82	0.00	20832.75	0.00	46018.21
48.00	1	8.51	-15.73	0.00	25187.15	-9.49	-15.73	0.00	20834.02	0.00	46021.18

LAUNCH RUNNER REPORT

TIME (SEC)	PHASE	LEFT CONTACT POINT COORD. X M	Y M	Z M	NORMAL FORCE KN	RIGHT CONTACT POINT COORD. X M	Y M	Z M	NORMAL FORCE KN	ROCKER PIN ANGLE DEG	TOTAL NORMAL FORCE KN
48.50	1	8.51	-15.65	0.00	25189.16	-9.49	-15.65	0.00	20836.75	0.00	46025.90
49.00	1	8.51	-15.57	0.00	25190.69	-9.49	-15.57	0.00	20839.80	0.00	46030.49
49.50	1	8.51	-15.48	0.00	25190.80	-9.49	-15.48	0.00	20841.71	0.00	46032.52
50.00	1	8.51	-15.40	0.00	25188.91	-9.49	-15.40	0.00	20841.28	0.00	46030.19
50.50	1	8.51	-15.32	0.00	25185.02	-9.49	-15.32	0.00	20838.21	0.00	46023.23
51.00	1	8.51	-15.24	0.00	25180.03	-9.49	-15.24	0.00	20833.28	0.00	46013.32
51.50	1	8.51	-15.15	0.00	25175.35	-9.49	-15.15	0.00	20828.21	0.00	46003.55
52.00	1	8.51	-15.07	0.00	25172.55	-9.49	-15.07	0.00	20824.85	0.00	45997.40
52.50	1	8.51	-14.99	0.00	25172.67	-9.49	-14.99	0.00	20824.61	0.00	45997.28
53.00	1	8.51	-14.90	0.00	25175.83	-9.49	-14.90	0.00	20827.71	0.00	46003.54
53.50	1	8.51	-14.82	0.00	25181.13	-9.49	-14.82	0.00	20833.06	0.00	46014.19
54.00	1	8.51	-14.74	0.00	25186.87	-9.49	-14.74	0.00	20838.74	0.00	46025.61
54.50	1	8.51	-14.65	0.00	25191.24	-9.49	-14.65	0.00	20842.64	0.00	46033.88
55.00	1	8.51	-14.57	0.00	25192.92	-9.49	-14.57	0.00	20843.38	0.00	46036.30
55.50	1	8.51	-14.49	0.00	25191.56	-9.49	-14.49	0.00	20840.79	0.00	46032.35
56.00	1	8.51	-14.41	0.00	25187.84	-9.49	-14.41	0.00	20836.04	0.00	46023.88
56.50	1	8.51	-14.32	0.00	25183.20	-9.49	-14.32	0.00	20831.03	0.00	46014.23
57.00	1	8.51	-14.24	0.00	25179.21	-9.49	-14.24	0.00	20827.71	0.00	46006.93
57.50	1	8.51	-14.16	0.00	25177.00	-9.49	-14.16	0.00	20827.17	0.00	46004.17
58.00	1	8.51	-14.07	0.00	25176.78	-9.49	-14.07	0.00	20829.27	0.00	46006.05
58.50	1	8.51	-13.99	0.00	25177.98	-9.49	-13.99	0.00	20832.71	0.00	46010.69
59.00	1	8.51	-13.91	0.00	25179.47	-9.49	-13.91	0.00	20835.68	0.00	46015.15
59.50	1	8.51	-13.82	0.00	25180.29	-9.49	-13.82	0.00	20836.63	0.00	46016.91
60.00	1	8.51	-13.74	0.00	25179.97	-9.49	-13.74	0.00	20835.09	0.00	46015.06
60.50	1	8.51	-13.66	0.00	25178.90	-9.49	-13.66	0.00	20831.76	0.00	46010.66
61.00	1	8.51	-13.58	0.00	25178.02	-9.49	-13.58	0.00	20828.31	0.00	46006.33
61.50	1	8.51	-13.49	0.00	25178.35	-9.49	-13.49	0.00	20826.59	0.00	46004.93
62.00	1	8.51	-13.41	0.00	25180.47	-9.49	-13.41	0.00	20827.73	0.00	46008.21
62.50	1	8.51	-13.33	0.00	25184.05	-9.49	-13.33	0.00	20831.65	0.00	46015.70
63.00	1	8.51	-13.24	0.00	25187.90	-9.49	-13.24	0.00	20836.84	0.00	46024.73
63.50	1	8.51	-13.16	0.00	25190.39	-9.49	-13.16	0.00	20841.12	0.00	46031.51
64.00	1	8.51	-13.08	0.00	25190.12	-9.49	-13.08	0.00	20842.43	0.00	46032.55
64.50	1	8.51	-12.99	0.00	25186.57	-9.49	-12.99	0.00	20839.82	0.00	46026.40
65.00	1	8.51	-12.91	0.00	25180.46	-9.49	-12.91	0.00	20833.89	0.00	46014.34
65.50	1	8.51	-12.83	0.00	25173.54	-9.49	-12.83	0.00	20826.64	0.00	46000.18
66.00	1	8.51	-12.75	0.00	25168.12	-9.49	-12.75	0.00	20820.75	0.00	45988.86
66.50	1	8.51	-12.66	0.00	25166.04	-9.49	-12.66	0.00	20818.48	0.00	45984.52
67.00	1	8.51	-12.58	0.00	25168.11	-9.49	-12.58	0.00	20820.79	0.00	45988.89
67.50	1	8.51	-12.50	0.00	25173.63	-9.49	-12.50	0.00	20826.82	0.00	46000.45
68.00	1	8.51	-12.41	0.00	25180.72	-9.49	-12.41	0.00	20834.31	0.00	46015.02
68.50	1	8.51	-12.33	0.00	25186.96	-9.49	-12.33	0.00	20840.40	0.00	46027.36
69.00	1	8.51	-12.25	0.00	25190.33	-9.49	-12.25	0.00	20842.84	0.00	46033.17
69.50	1	8.51	-12.16	0.00	25189.94	-9.49	-12.16	0.00	20840.85	0.00	46030.79
70.00	1	8.51	-12.08	0.00	25186.27	-9.49	-12.08	0.00	20835.40	0.00	46021.68
70.50	1	8.51	-12.00	0.00	25180.99	-9.49	-12.00	0.00	20828.83	0.00	46009.81

********** LAUNCH RUNNER REPORT **********

TIME (SEC)	PHASE	LEFT CONTACT POINT COORD. X M	Y M	Z M	NORMAL FORCE KN	RIGHT CONTACT POINT COORD. X M	Y M	Z M	NORMAL FORCE KN	ROCKER PIN ANGLE DEG	TOTAL NORMAL FORCE KN
71.00	1	8.51	-11.92	0.00	25176.15	-9.49	-11.92	0.00	20823.77	0.00	45999.93
71.50	1	8.51	-11.83	0.00	25173.39	-9.49	-11.83	0.00	20822.18	0.00	45995.57
72.00	1	8.51	-11.75	0.00	25173.31	-9.49	-11.75	0.00	20824.36	0.00	45997.68
72.50	1	8.51	-11.67	0.00	25175.21	-9.49	-11.67	0.00	20829.03	0.00	46004.24
73.00	1	8.51	-11.58	0.00	25177.59	-9.49	-11.58	0.00	20833.79	0.00	46011.38
73.50	1	8.51	-11.50	0.00	25178.88	-9.49	-11.50	0.00	20836.25	0.00	46015.14
74.00	1	8.51	-11.42	0.00	25178.17	-9.49	-11.42	0.00	20835.16	0.00	46013.33
74.50	1	8.51	-11.33	0.00	25175.68	-9.49	-11.33	0.00	20830.84	0.00	46006.52
75.00	1	8.51	-11.25	0.00	25172.68	-9.49	-11.25	0.00	20825.22	0.00	45997.90
75.50	1	8.51	-11.17	0.00	25170.94	-9.49	-11.17	0.00	20820.92	0.00	45991.86
76.00	1	8.51	-11.09	0.00	25171.84	-9.49	-11.09	0.00	20820.16	0.00	45992.00
76.50	1	8.51	-11.00	0.00	25175.72	-9.49	-11.00	0.00	20823.71	0.00	45999.42
77.00	1	8.51	-10.92	0.00	25181.47	-9.49	-10.92	0.00	20830.43	0.00	46011.91
77.50	1	8.51	-10.84	0.00	25187.02	-9.49	-10.84	0.00	20837.72	0.00	46024.74
78.00	1	8.51	-10.75	0.00	25189.98	-9.49	-10.75	0.00	20842.48	0.00	46032.46
78.50	1	8.51	-10.67	0.00	25188.78	-9.49	-10.67	0.00	20842.48	0.00	46031.26
79.00	1	8.51	-10.59	0.00	25183.25	-9.49	-10.59	0.00	20837.29	0.00	46020.54
79.50	1	8.51	-10.50	0.00	25174.91	-9.49	-10.50	0.00	20828.53	0.00	46003.45
80.00	1	8.51	-10.42	0.00	25166.46	-9.49	-10.42	0.00	20819.37	0.00	45985.83
80.50	1	8.51	-10.34	0.00	25160.78	-9.49	-10.34	0.00	20813.21	0.00	45973.99
81.00	1	8.51	-10.26	0.00	25159.86	-9.49	-10.26	0.00	20812.43	0.00	45972.29
81.50	1	8.51	-10.17	0.00	25164.01	-9.49	-10.17	0.00	20817.32	0.00	45981.33
82.00	1	8.51	-10.09	0.00	25171.70	-9.49	-10.09	0.00	20825.97	0.00	45997.68
82.50	1	8.51	-10.01	0.00	25180.15	-9.49	-10.01	0.00	20835.06	0.00	46015.21
83.00	1	8.51	-9.92	0.00	25186.43	-9.49	-9.92	0.00	20841.09	0.00	46027.51
83.50	1	8.51	-9.84	0.00	25188.52	-9.49	-9.84	0.00	20841.87	0.00	46030.39
84.00	1	8.51	-9.76	0.00	25186.05	-9.49	-9.76	0.00	20837.32	0.00	46023.38
84.50	1	8.51	-9.67	0.00	25180.37	-9.49	-9.67	0.00	20829.46	0.00	46009.83
85.00	1	8.51	-9.59	0.00	25173.92	-9.49	-9.59	0.00	20821.59	0.00	45995.51
85.50	1	8.51	-9.51	0.00	25169.21	-9.49	-9.51	0.00	20816.89	0.00	45986.10
86.00	1	8.51	-9.43	0.00	25167.83	-9.49	-9.43	0.00	20817.11	0.00	45984.94
86.50	1	8.51	-9.34	0.00	25169.73	-9.49	-9.34	0.00	20821.84	0.00	45991.56
87.00	1	8.51	-9.26	0.00	25173.42	-9.49	-9.26	0.00	20828.73	0.00	46002.15
87.50	1	8.51	-9.18	0.00	25176.67	-9.49	-9.18	0.00	20834.50	0.00	46011.17
88.00	1	8.51	-9.09	0.00	25177.54	-9.49	-9.09	0.00	20836.40	0.00	46013.94
88.50	1	8.51	-9.01	0.00	25175.30	-9.49	-9.01	0.00	20833.36	0.00	46008.66
89.00	1	8.51	-8.93	0.00	25170.78	-9.49	-8.93	0.00	20826.50	0.00	45997.28
89.50	1	8.51	-8.84	0.00	25166.05	-9.49	-8.84	0.00	20818.76	0.00	45984.82
90.00	1	8.51	-8.76	0.00	25163.56	-9.49	-8.76	0.00	20813.58	0.00	45977.14
90.50	1	8.51	-8.68	0.00	25165.02	-9.49	-8.68	0.00	20813.51	0.00	45978.52
91.00	1	8.51	-8.60	0.00	25170.49	-9.49	-8.60	0.00	20819.02	0.00	45989.52
91.50	1	8.51	-8.51	0.00	25178.31	-9.49	-8.51	0.00	20828.21	0.00	46006.52
92.00	1	8.51	-8.43	0.00	25185.57	-9.49	-8.43	0.00	20837.47	0.00	46023.04
92.50	1	8.51	-8.35	0.00	25189.26	-9.49	-8.35	0.00	20842.97	0.00	46032.23
93.00	1	8.51	-8.26	0.00	25187.53	-9.49	-8.26	0.00	20842.23	0.00	46029.75

********** LAUNCH RUNNER REPORT **********

TIME (SEC)	PHASE	LEFT CONTACT POINT COORD. X M	Y M	Z M	NORMAL FORCE KN	RIGHT CONTACT POINT COORD. X M	Y M	Z M	NORMAL FORCE KN	ROCKER PIN ANGLE DEG	TOTAL NORMAL FORCE KN
93.50	1	8.51	-8.18	0.00	25180.44	-9.49	-8.18	0.00	20835.09	0.00	46015.53
94.00	1	8.51	-8.10	0.00	25170.13	-9.49	-8.10	0.00	20823.93	0.00	45994.06
94.50	1	8.51	-8.01	0.00	25160.01	-9.49	-8.01	0.00	20812.84	0.00	45972.85
95.00	1	8.51	-7.93	0.00	25153.61	-9.49	-7.93	0.00	20805.92	0.00	45959.53
95.50	1	8.51	-7.85	0.00	25153.12	-9.49	-7.85	0.00	20805.84	0.00	45958.96
96.00	1	8.51	-7.77	0.00	25158.62	-9.49	-7.77	0.00	20812.61	0.00	45971.23
96.50	1	8.51	-7.68	0.00	25168.07	-9.49	-7.68	0.00	20823.54	0.00	45991.61
97.00	1	8.51	-7.60	0.00	25177.96	-9.49	-7.60	0.00	20834.46	0.00	46012.43
97.50	1	8.51	-7.52	0.00	25184.82	-9.49	-7.52	0.00	20841.20	0.00	46026.02
98.00	1	8.51	-7.43	0.00	25186.43	-9.49	-7.43	0.00	20841.35	0.00	46027.78
98.50	1	8.51	-7.35	0.00	25182.60	-9.49	-7.35	0.00	20835.06	0.00	46017.66
99.00	1	8.51	-7.27	0.00	25175.24	-9.49	-7.27	0.00	20825.04	0.00	46000.28
99.50	1	8.51	-7.18	0.00	25167.45	-9.49	-7.18	0.00	20815.40	0.00	45982.85
100.00	1	8.51	-7.10	0.00	25162.29	-9.49	-7.10	0.00	20809.97	0.00	45972.26
100.50	1	8.51	-7.02	0.00	25161.49	-9.49	-7.02	0.00	20810.80	0.00	45972.29
101.00	1	8.51	-6.94	0.00	25164.82	-9.49	-6.94	0.00	20817.23	0.00	45982.05
101.50	1	8.51	-6.85	0.00	25170.25	-9.49	-6.85	0.00	20826.24	0.00	45996.49
102.00	1	8.51	-6.77	0.00	25174.88	-9.49	-6.77	0.00	20833.74	0.00	46008.62
102.50	1	8.51	-6.69	0.00	25176.24	-9.49	-6.69	0.00	20836.31	0.00	46012.55
103.00	1	8.51	-6.60	0.00	25173.38	-9.49	-6.60	0.00	20832.61	0.00	46005.98
103.50	1	8.51	-6.52	0.00	25167.31	-9.49	-6.52	0.00	20823.96	0.00	45991.27
104.00	1	8.51	-6.44	0.00	25160.63	-9.49	-6.44	0.00	20813.93	0.00	45974.56
104.50	1	8.51	-6.35	0.00	25156.51	-9.49	-6.35	0.00	20806.78	0.00	45963.29
105.00	1	8.51	-6.27	0.00	25157.21	-9.49	-6.27	0.00	20805.82	0.00	45963.04
105.50	1	8.51	-6.19	0.00	25163.16	-9.49	-6.19	0.00	20811.90	0.00	45975.06
106.00	1	8.51	-6.11	0.00	25172.50	-9.49	-6.11	0.00	20822.93	0.00	45995.43
106.50	1	8.51	-6.02	0.00	25181.81	-9.49	-6.02	0.00	20834.71	0.00	46016.53
107.00	1	8.51	-5.94	0.00	25187.38	-9.49	-5.94	0.00	20842.51	0.00	46029.89
107.50	1	8.51	-5.86	0.00	25186.67	-9.49	-5.86	0.00	20842.99	0.00	46029.66
108.00	1	8.51	-5.77	0.00	25179.38	-9.49	-5.77	0.00	20835.56	0.00	46014.94
108.50	1	8.51	-5.69	0.00	25167.65	-9.49	-5.69	0.00	20822.64	0.00	45990.30
109.00	1	8.51	-5.61	0.00	25155.41	-9.49	-5.61	0.00	20808.91	0.00	45964.32
109.50	1	8.51	-5.52	0.00	25146.88	-9.49	-5.52	0.00	20799.39	0.00	45946.27
110.00	1	8.51	-5.44	0.00	25145.04	-9.49	-5.44	0.00	20797.71	0.00	45942.74
110.50	1	8.51	-5.36	0.00	25150.49	-9.49	-5.36	0.00	20804.43	0.00	45954.92
111.00	1	8.51	-5.28	0.00	25161.14	-9.49	-5.28	0.00	20816.97	0.00	45978.11
111.50	1	8.51	-5.19	0.00	25173.11	-9.49	-5.19	0.00	20830.52	0.00	46003.63
112.00	1	8.51	-5.11	0.00	25182.12	-9.49	-5.11	0.00	20839.99	0.00	46022.11
112.50	1	8.51	-5.03	0.00	25185.17	-9.49	-5.03	0.00	20841.92	0.00	46027.09
113.00	1	8.51	-4.94	0.00	25181.55	-9.49	-4.94	0.00	20835.75	0.00	46017.30
113.50	1	8.51	-4.86	0.00	25173.03	-9.49	-4.86	0.00	20824.13	0.00	45997.15
114.00	1	8.51	-4.78	0.00	25163.16	-9.49	-4.78	0.00	20811.69	0.00	45974.85
114.50	1	8.51	-4.69	0.00	25155.78	-9.49	-4.69	0.00	20803.33	0.00	45959.11
115.00	1	8.51	-4.61	0.00	25153.51	-9.49	-4.61	0.00	20802.24	0.00	45955.75
115.50	1	8.51	-4.53	0.00	25156.76	-9.49	-4.53	0.00	20808.56	0.00	45965.31

********** LAUNCH RUNNER REPORT **********

TIME (SEC)	PHASE	LEFT CONTACT POINT COORD. X M	Y M	Z M	NORMAL FORCE KN	RIGHT CONTACT POINT COORD. X M	Y M	Z M	NORMAL FORCE KN	ROCKER PIN ANGLE DEG	TOTAL NORMAL FORCE KN
116.00	1	8.51	-4.45	0.00	25163.55	-9.49	-4.45	0.00	20819.40	0.00	45982.95
116.50	1	8.51	-4.36	0.00	25170.50	-9.49	-4.36	0.00	20830.05	0.00	46000.56
117.00	1	8.51	-4.28	0.00	25174.25	-9.49	-4.28	0.00	20835.90	0.00	46010.15
117.50	1	8.51	-4.20	0.00	25172.87	-9.49	-4.20	0.00	20834.34	0.00	46007.20
118.00	1	8.51	-4.11	0.00	25166.66	-9.49	-4.11	0.00	20825.76	0.00	45992.42
118.50	1	8.51	-4.03	0.00	25158.18	-9.49	-4.03	0.00	20813.55	0.00	45971.74
119.00	1	8.51	-3.95	0.00	25151.10	-9.49	-3.95	0.00	20802.71	0.00	45953.80
119.50	1	8.51	-3.86	0.00	25148.80	-9.49	-3.86	0.00	20797.84	0.00	45946.64
120.00	1	8.51	-3.78	0.00	25152.85	-9.49	-3.78	0.00	20801.34	0.00	45954.18
120.50	1	8.51	-3.70	0.00	25162.26	-9.49	-3.70	0.00	20812.20	0.00	45974.46
121.00	1	8.51	-3.62	0.00	25173.70	-9.49	-3.62	0.00	20826.44	0.00	46000.13
121.50	1	8.51	-3.53	0.00	25182.82	-9.49	-3.53	0.00	20838.49	0.00	46021.31
122.00	1	8.51	-3.45	0.00	25185.86	-9.49	-3.45	0.00	20843.51	0.00	46029.36
122.50	1	8.51	-3.37	0.00	25181.12	-9.49	-3.37	0.00	20839.19	0.00	46020.31
123.00	1	8.51	-3.28	0.00	25169.75	-9.49	-3.28	0.00	20826.68	0.00	45996.43
123.50	1	8.51	-3.20	0.00	25155.42	-9.49	-3.20	0.00	20810.32	0.00	45965.74
124.00	1	8.51	-3.12	0.00	25142.99	-9.49	-3.12	0.00	20796.05	0.00	45939.04
124.50	1	8.51	-3.03	0.00	25136.81	-9.49	-3.03	0.00	20789.10	0.00	45925.91
125.00	1	8.51	-2.95	0.00	25139.07	-9.49	-2.95	0.00	20792.11	0.00	45931.18
125.50	1	8.51	-2.87	0.00	25148.89	-9.49	-2.87	0.00	20803.92	0.00	45952.81
126.00	1	8.51	-2.79	0.00	25162.71	-9.49	-2.79	0.00	20820.14	0.00	45982.85
126.50	1	8.51	-2.70	0.00	25175.61	-9.49	-2.70	0.00	20834.71	0.00	46010.32
127.00	1	8.51	-2.62	0.00	25183.09	-9.49	-2.62	0.00	20842.33	0.00	46025.43
127.50	1	8.51	-2.54	0.00	25182.83	-9.49	-2.54	0.00	20840.31	0.00	46023.14
128.00	1	8.51	-2.45	0.00	25175.27	-9.49	-2.45	0.00	20829.61	0.00	46004.87
128.50	1	8.51	-2.37	0.00	25163.54	-9.49	-2.37	0.00	20814.46	0.00	45978.00
129.00	1	8.51	-2.29	0.00	25152.19	-9.49	-2.29	0.00	20800.67	0.00	45952.86
129.50	1	8.51	-2.20	0.00	25145.35	-9.49	-2.20	0.00	20793.46	0.00	45938.81
130.00	1	8.51	-2.12	0.00	25145.27	-9.49	-2.12	0.00	20795.40	0.00	45940.67
130.50	1	8.51	-2.04	0.00	25151.35	-9.49	-2.04	0.00	20805.36	0.00	45956.71
131.00	1	8.51	-1.96	0.00	25160.59	-9.49	-1.96	0.00	20819.07	0.00	45979.66
131.27	1	8.51	-1.91	0.00	25165.44	-9.49	-1.91	0.00	20826.10	0.00	45991.54
131.34	1	8.51	-1.90	0.00	25166.51	-9.49	-1.90	0.00	20827.63	0.00	45994.15
131.35	1	8.51	-1.90	0.00	25166.64	-9.49	-1.90	0.00	20827.80	0.00	45994.45
131.35	1	8.51	-1.90	0.00	25166.65	-9.49	-1.90	0.00	20827.82	0.00	45994.47
131.35	2	8.51	-1.90	0.00	25166.65	-9.49	-1.90	0.00	20827.82	0.00	45994.48
132.00	2	8.51	-1.79	0.00	25173.36	-9.49	-1.79	0.00	20836.51	0.00	46009.87
132.50	2	8.51	-1.70	0.00	25169.45	-9.49	-1.70	0.00	20831.57	0.00	46001.02
133.00	2	8.51	-1.62	0.00	25159.13	-9.49	-1.62	0.00	20818.31	0.00	45977.43
133.50	2	8.51	-1.53	0.00	25147.28	-9.49	-1.53	0.00	20802.52	0.00	45949.80
134.00	2	8.51	-1.44	0.00	25139.73	-9.49	-1.44	0.00	20791.35	0.00	45931.08
134.20	2	8.51	-1.41	0.00	25140.83	-9.49	-1.41	0.00	20790.87	0.00	45931.70
134.40	2	8.51	-1.38	0.00	25142.10	-9.49	-1.38	0.00	20791.15	0.00	45933.25
134.60	2	8.51	-1.35	0.00	25144.15	-9.49	-1.35	0.00	20792.66	0.00	45936.80
134.80	2	8.51	-1.31	0.00	25147.14	-9.49	-1.31	0.00	20795.53	0.00	45942.66

********** LAUNCH RUNNER REPORT **********

TIME (SEC)	PHASE	LEFT CONTACT POINT COORD. X M	Y M	Z M	NORMAL FORCE KN	RIGHT CONTACT POINT COORD. X M	Y M	Z M	NORMAL FORCE KN	ROCKER PIN ANGLE DEG	TOTAL NORMAL FORCE KN
135.00	2	8.51	-1.28	0.00	25150.96	-9.49	-1.28	0.00	20799.62	0.00	45950.58
135.20	2	8.51	-1.25	0.00	25155.47	-9.49	-1.25	0.00	20804.74	0.00	45960.22
135.40	2	8.51	-1.21	0.00	25160.45	-9.49	-1.21	0.00	20810.60	0.00	45971.05
135.60	2	8.51	-1.18	0.00	25165.82	-9.49	-1.18	0.00	20817.03	0.00	45982.84
135.80	2	8.51	-1.15	0.00	25171.54	-9.49	-1.15	0.00	20823.81	0.00	45995.36
136.00	2	8.51	-1.11	0.00	25176.69	-9.49	-1.11	0.00	20830.09	0.00	46006.78
136.20	2	8.51	-1.08	0.00	25180.83	-9.49	-1.08	0.00	20835.39	0.00	46016.22
136.40	2	8.51	-1.04	0.00	25183.66	-9.49	-1.04	0.00	20839.31	0.00	46022.97
136.60	2	8.51	-1.01	0.00	25184.91	-9.49	-1.01	0.00	20841.57	0.00	46026.48
136.80	2	8.51	-0.97	0.00	25184.43	-9.49	-0.97	0.00	20841.96	0.00	46026.39
137.00	2	8.51	-0.93	0.00	25182.19	-9.49	-0.93	0.00	20840.38	0.00	46022.57
137.20	2	8.51	-0.89	0.00	25178.23	-9.49	-0.89	0.00	20836.94	0.00	46015.16
137.40	2	8.51	-0.85	0.00	25172.75	-9.49	-0.85	0.00	20831.77	0.00	46004.52
137.60	2	8.51	-0.81	0.00	25166.04	-9.49	-0.81	0.00	20825.19	0.00	45991.23
137.80	2	8.51	-0.77	0.00	25158.47	-9.49	-0.77	0.00	20817.57	0.00	45976.04
138.00	2	8.51	-0.73	0.00	25150.47	-9.49	-0.73	0.00	20809.40	0.00	45959.87
138.20	2	8.51	-0.68	0.00	25142.52	-9.49	-0.68	0.00	20801.18	0.00	45943.70
138.40	2	8.51	-0.64	0.00	25135.08	-9.49	-0.64	0.00	20793.46	0.00	45928.54
138.60	2	8.51	-0.59	0.00	25128.62	-9.49	-0.59	0.00	20786.70	0.00	45915.32
138.80	2	8.51	-0.55	0.00	25123.53	-9.49	-0.55	0.00	20781.33	0.00	45904.86
139.00	2	8.51	-0.50	0.00	25120.11	-9.49	-0.50	0.00	20777.72	0.00	45897.84
139.20	2	8.51	-0.46	0.00	25118.59	-9.49	-0.46	0.00	20776.08	0.00	45894.68
139.40	2	8.51	-0.42	0.00	25119.05	-9.49	-0.42	0.00	20776.54	0.00	45895.58
139.60	2	8.51	-0.37	0.00	25121.45	-9.49	-0.37	0.00	20779.04	0.00	45900.48
139.80	2	8.51	-0.33	0.00	25125.64	-9.49	-0.33	0.00	20783.42	0.00	45909.05
140.00	2	8.51	-0.28	0.00	25131.33	-9.49	-0.28	0.00	20789.38	0.00	45920.71
140.20	2	8.51	-0.24	0.00	25138.17	-9.49	-0.24	0.00	20796.54	0.00	45934.71
140.40	2	8.51	-0.19	0.00	25145.74	-9.49	-0.19	0.00	20804.38	0.00	45950.12
140.60	2	8.51	-0.14	0.00	25153.53	-9.49	-0.14	0.00	20812.43	0.00	45965.95
140.80	2	8.51	-0.09	0.00	25161.05	-9.49	-0.09	0.00	20820.15	0.00	45981.20
141.00	2	8.51	-0.04	0.00	25167.88	-9.49	-0.04	0.00	20827.03	0.00	45994.92
141.20	2	8.51	0.01	0.00	25173.57	-9.49	0.01	0.00	20832.65	0.00	46006.22
141.40	2	8.51	0.06	0.00	25177.80	-9.49	0.06	0.00	20836.64	0.00	46014.44
141.60	2	8.51	0.12	0.00	25180.30	-9.49	0.12	0.00	20838.78	0.00	46019.08
141.80	2	8.51	0.17	0.00	25180.97	-9.49	0.17	0.00	20838.89	0.00	46019.86
142.00	2	8.51	0.23	0.00	25179.78	-9.49	0.23	0.00	20837.00	0.00	46016.77
142.20	2	8.51	0.30	0.00	25176.81	-9.49	0.30	0.00	20833.23	0.00	46010.05
142.40	2	8.51	0.36	0.00	25172.28	-9.49	0.36	0.00	20827.85	0.00	46000.12
142.60	2	8.51	0.42	0.00	25166.47	-9.49	0.42	0.00	20821.17	0.00	45987.64
142.80	2	8.51	0.49	0.00	25159.76	-9.49	0.49	0.00	20813.66	0.00	45973.42
143.00	2	8.51	0.56	0.00	25152.58	-9.49	0.56	0.00	20805.77	0.00	45958.35
143.20	2	8.51	0.63	0.00	25145.37	-9.49	0.63	0.00	20798.03	0.00	45943.40
143.40	2	8.51	0.70	0.00	25138.56	-9.49	0.70	0.00	20790.90	0.00	45929.46
143.60	2	8.51	0.77	0.00	25132.54	-9.49	0.77	0.00	20784.82	0.00	45917.36
143.80	2	8.51	0.85	0.00	25127.65	-9.49	0.85	0.00	20780.17	0.00	45907.82

LAUNCH RUNNER REPORT

TIME (SEC)	PHASE	LEFT CONTACT POINT COORD. X M	Y M	Z M	NORMAL FORCE KN	RIGHT CONTACT POINT COORD. X M	Y M	Z M	NORMAL FORCE KN	ROCKER PIN ANGLE DEG	TOTAL NORMAL FORCE KN
144.00	2	8.51	0.92	0.00	25124.15	-9.49	0.92	0.00	20777.19	0.00	45901.34
144.20	2	8.51	1.00	0.00	25122.16	-9.49	1.00	0.00	20776.04	0.00	45898.20
144.40	2	8.51	1.08	0.00	25121.75	-9.49	1.08	0.00	20776.71	0.00	45898.46
144.60	2	8.51	1.16	0.00	25122.81	-9.49	1.16	0.00	20779.11	0.00	45901.91
144.80	2	8.51	1.24	0.00	25125.18	-9.49	1.24	0.00	20782.98	0.00	45908.16
145.00	2	8.51	1.32	0.00	25128.57	-9.49	1.32	0.00	20788.00	0.00	45916.58
145.20	2	8.51	1.41	0.00	25132.69	-9.49	1.41	0.00	20793.76	0.00	45926.45
145.40	2	8.51	1.49	0.00	25137.13	-9.49	1.49	0.00	20799.79	0.00	45936.92
145.60	2	8.51	1.58	0.00	25141.51	-9.49	1.58	0.00	20805.61	0.00	45947.12
145.80	2	8.51	1.68	0.00	25145.41	-9.49	1.68	0.00	20810.80	0.00	45956.21
146.00	2	8.51	1.77	0.00	25148.53	-9.49	1.77	0.00	20814.91	0.00	45963.44
146.20	2	8.51	1.87	0.00	25150.57	-9.49	1.87	0.00	20817.62	0.00	45968.19
146.40	2	8.51	1.97	0.00	25151.33	-9.49	1.97	0.00	20818.72	0.00	45970.05
146.60	2	8.51	2.08	0.00	25150.70	-9.49	2.08	0.00	20818.06	0.00	45968.76
146.80	2	8.51	2.18	0.00	25148.65	-9.49	2.18	0.00	20815.63	0.00	45964.28
147.00	2	8.51	2.30	0.00	25145.28	-9.49	2.30	0.00	20811.53	0.00	45956.80
147.20	2	8.51	2.41	0.00	25140.72	-9.49	2.41	0.00	20805.98	0.00	45946.71
147.40	2	8.51	2.53	0.00	25135.28	-9.49	2.53	0.00	20799.28	0.00	45934.56
147.60	2	8.51	2.65	0.00	25129.23	-9.49	2.65	0.00	20791.82	0.00	45921.05
147.80	2	8.51	2.78	0.00	25122.91	-9.49	2.78	0.00	20784.03	0.00	45906.94
148.00	2	8.51	2.90	0.00	25116.69	-9.49	2.90	0.00	20776.35	0.00	45893.04
148.20	2	8.51	3.04	0.00	25110.96	-9.49	3.04	0.00	20769.18	0.00	45880.14
148.40	2	8.51	3.17	0.00	25106.00	-9.49	3.17	0.00	20762.99	0.00	45868.99
148.60	2	8.51	3.31	0.00	25102.02	-9.49	3.31	0.00	20757.99	0.00	45860.01
148.80	2	8.51	3.45	0.00	25099.22	-9.49	3.45	0.00	20754.43	0.00	45853.66
149.00	2	8.51	3.60	0.00	25097.62	-9.49	3.60	0.00	20752.40	0.00	45850.02
149.20	2	8.51	3.75	0.00	25097.17	-9.49	3.75	0.00	20751.85	0.00	45849.02
149.40	2	8.51	3.90	0.00	25097.75	-9.49	3.90	0.00	20752.62	0.00	45850.36
149.60	2	8.51	4.05	0.00	25099.11	-9.49	4.05	0.00	20754.49	0.00	45853.61
149.80	2	8.51	4.21	0.00	25100.87	-9.49	4.21	0.00	20756.99	0.00	45857.86
150.00	2	8.51	4.38	0.00	25102.66	-9.49	4.38	0.00	20759.72	0.00	45862.38
150.20	2	8.51	4.55	0.00	25104.20	-9.49	4.55	0.00	20762.42	0.00	45866.62
150.40	2	8.51	4.72	0.00	25104.73	-9.49	4.72	0.00	20764.07	0.00	45868.80
150.60	2	8.51	4.90	0.00	25103.89	-9.49	4.90	0.00	20764.41	0.00	45868.30
150.80	2	8.51	5.09	0.00	25101.38	-9.49	5.09	0.00	20762.99	0.00	45864.37
151.00	2	8.51	5.28	0.00	25096.93	-9.49	5.28	0.00	20759.51	0.00	45856.43
151.20	2	8.51	5.48	0.00	25090.32	-9.49	5.48	0.00	20753.75	0.00	45844.07
151.40	2	8.51	5.68	0.00	25081.51	-9.49	5.68	0.00	20745.60	0.00	45827.12
151.60	2	8.51	5.89	0.00	25070.70	-9.49	5.89	0.00	20735.30	0.00	45806.00
151.80	2	8.51	6.10	0.00	25057.65	-9.49	6.10	0.00	20722.53	0.00	45780.18
152.00	2	8.51	6.32	0.00	25042.73	-9.49	6.32	0.00	20707.67	0.00	45750.41
152.20	2	8.51	6.55	0.00	25026.20	-9.49	6.55	0.00	20691.06	0.00	45717.26
152.40	2	8.51	6.79	0.00	25008.38	-9.49	6.79	0.00	20672.93	0.00	45681.31
152.60	2	8.51	7.03	0.00	24989.59	-9.49	7.03	0.00	20653.80	0.00	45643.39
152.80	2	8.51	7.28	0.00	24970.30	-9.49	7.28	0.00	20634.10	0.00	45604.40

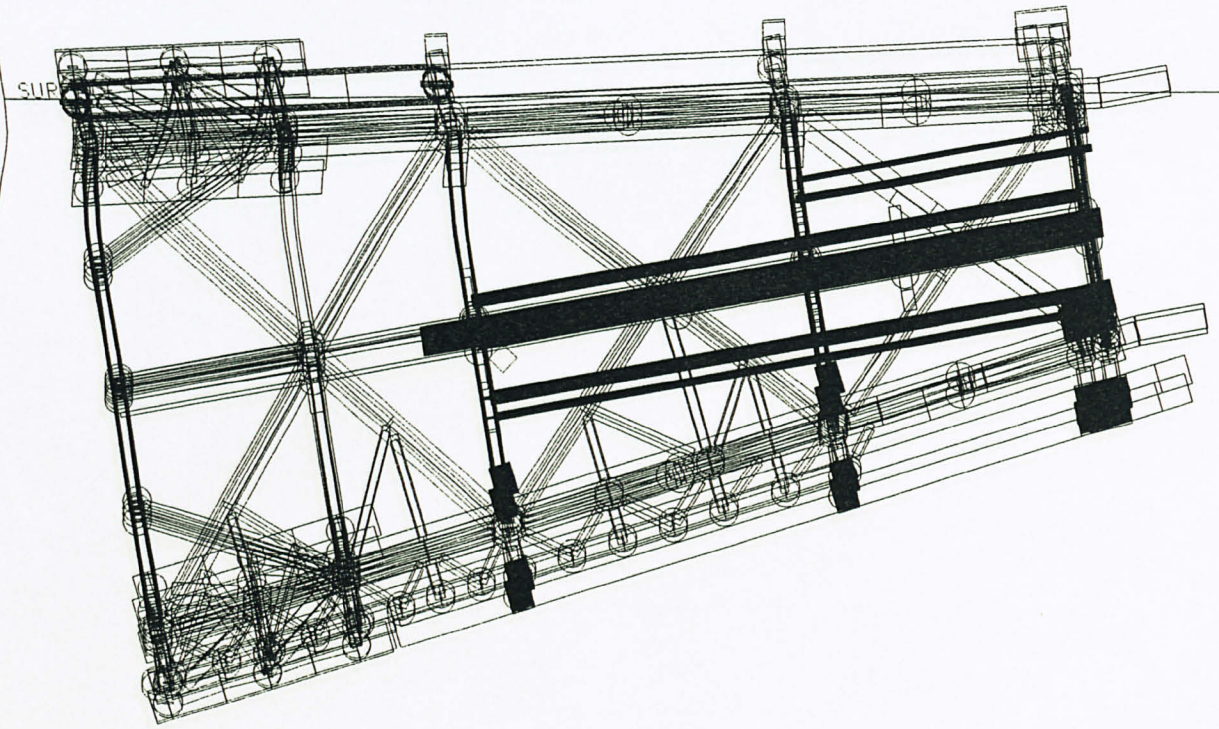
LAUNCH RUNNER REPORT

TIME (SEC)	PHASE	LEFT CONTACT POINT COORD. X M	Y M	Z M	NORMAL FORCE KN	RIGHT CONTACT POINT COORD. X M	Y M	Z M	NORMAL FORCE KN	ROCKER PIN ANGLE DEG	TOTAL NORMAL FORCE KN
153.00	2	8.51	7.53	0.00	24950.98	-9.49	7.53	0.00	20614.37	0.00	45565.35
153.20	2	8.51	7.79	0.00	24931.61	-9.49	7.79	0.00	20594.56	0.00	45526.17
153.40	2	8.51	8.06	0.00	24912.34	-9.49	8.06	0.00	20574.48	0.00	45486.82
153.60	2	8.51	8.34	0.00	24893.82	-9.49	8.34	0.00	20555.69	0.00	45449.50
153.80	2	8.51	8.62	0.00	24875.78	-9.49	8.62	0.00	20537.38	0.00	45413.16
154.00	2	8.51	8.91	0.00	24858.41	-9.49	8.91	0.00	20519.83	0.00	45378.24
154.20	2	8.51	9.20	0.00	24841.32	-9.49	9.20	0.00	20502.60	0.00	45343.91
154.40	2	8.51	9.51	0.00	24824.41	-9.49	9.51	0.00	20485.67	0.00	45310.08
154.60	2	8.51	9.82	0.00	24807.42	-9.49	9.82	0.00	20468.71	0.00	45276.13
154.80	2	8.51	10.14	0.00	24790.02	-9.49	10.14	0.00	20451.36	0.00	45241.38
155.00	2	8.51	10.47	0.00	24771.96	-9.49	10.47	0.00	20433.41	0.00	45205.36
155.20	2	8.51	10.81	0.00	24753.08	-9.49	10.81	0.00	20415.22	0.00	45168.30
155.40	2	8.51	11.15	0.00	24732.23	-9.49	11.15	0.00	20394.51	0.00	45126.73
155.60	2	8.51	11.51	0.00	24709.50	-9.49	11.51	0.00	20371.85	0.00	45081.34
155.80	2	8.51	11.88	0.00	24684.58	-9.49	11.88	0.00	20347.05	0.00	45031.64
156.00	2	8.51	12.25	0.00	24657.25	-9.49	12.25	0.00	20319.83	0.00	44977.07
156.20	2	8.51	12.64	0.00	24627.10	-9.49	12.64	0.00	20289.73	0.00	44916.83
156.40	2	8.51	13.04	0.00	24593.77	-9.49	13.04	0.00	20256.49	0.00	44850.27
156.60	2	8.51	13.45	0.00	24557.52	-9.49	13.45	0.00	20220.54	0.00	44778.06
156.80	2	8.51	13.87	0.00	24518.04	-9.49	13.87	0.00	20181.35	0.00	44699.39
157.00	2	8.51	14.31	0.00	24475.67	-9.49	14.31	0.00	20139.32	0.00	44614.99
157.20	2	8.51	14.75	0.00	24430.54	-9.49	14.75	0.00	20094.70	0.00	44525.24
157.40	2	8.51	15.21	0.00	24383.19	-9.49	15.21	0.00	20047.99	0.00	44431.17
157.60	2	8.51	15.68	0.00	24333.50	-9.49	15.68	0.00	19999.02	0.00	44332.52
157.80	2	8.51	16.16	0.00	24281.64	-9.49	16.16	0.00	19948.03	0.00	44229.67
158.00	2	8.51	16.66	0.00	24228.13	-9.49	16.66	0.00	19895.50	0.00	44123.63
158.20	2	8.51	17.17	0.00	24170.78	-9.49	17.17	0.00	19837.93	0.00	44008.71
158.40	2	8.51	17.69	0.00	24114.02	-9.49	17.69	0.00	19782.76	0.00	43896.79
158.58	2	8.51	18.16	0.00	24063.55	-9.49	18.16	0.00	19734.63	0.00	43798.19
158.58	2	8.51	18.17	0.00	24063.26	-9.49	18.17	0.00	19734.34	0.00	43797.60
158.58	4	8.51	18.17	0.00	24063.30	-9.49	18.17	0.00	19734.39	0.00	43797.70
159.00	4	8.51	19.33	0.00	24040.01	-9.49	19.33	0.00	19729.78	0.03	43769.79
159.50	4	8.51	20.72	0.00	23810.30	-9.49	20.72	0.00	19514.87	0.34	43325.17
160.00	4	8.51	22.09	0.00	23273.57	-9.49	22.09	0.00	18975.04	1.24	42248.61
160.50	4	8.51	23.44	0.00	22234.45	-9.49	23.44	0.00	17883.48	2.98	40117.93
161.00	4	8.51	24.89	0.00	20644.58	-9.49	24.89	0.00	16263.84	5.57	36908.43
161.50	4	8.51	26.61	0.00	18341.29	-9.49	26.61	0.00	14013.68	8.94	32354.98
162.00	4	8.51	28.76	0.00	15346.33	-9.49	28.76	0.00	11101.91	12.90	26448.25
162.50	4	8.51	31.49	0.00	11997.66	-9.49	31.49	0.00	8279.56	17.12	20277.21
162.75	4	8.51	33.10	0.00	10485.56	-9.49	33.10	0.00	7013.52	19.18	17499.08
162.88	4	8.51	33.97	0.00	9803.33	-9.49	33.97	0.00	6473.48	20.16	16276.81
163.00	4	8.51	34.88	0.00	9160.74	-9.49	34.88	0.00	5997.11	21.11	15157.84
163.20	4	8.51	36.42	0.00	8316.85	-9.49	36.42	0.00	5465.11	22.50	13781.96
163.40	4	8.51	38.04	0.00	7598.59	-9.49	38.04	0.00	5057.46	23.73	12656.06
163.49	4	8.51	38.76	0.00	7550.07	-9.49	38.76	0.00	4749.08	24.19	12299.16

********** LAUNCH RUNNER REPORT **********

TIME (SEC)	PHASE	LEFT CONTACT POINT COORD. X M	Y M	Z M	NORMAL FORCE KN	RIGHT CONTACT POINT COORD. X M	Y M	Z M	NORMAL FORCE KN	ROCKER PIN ANGLE DEG	TOTAL NORMAL FORCE KN
163.57	4	8.51	39.50	0.00	7139.86	-9.49	39.50	0.00	4820.89	24.63	11960.75
163.66	4	8.51	40.24	0.00	6879.28	-9.49	40.24	0.00	4763.01	25.02	11642.30
163.74	4	8.51	40.99	0.00	6616.50	-9.49	40.99	0.00	4587.91	25.38	11204.41
163.83	4	8.51	41.76	0.00	6252.69	-9.49	41.76	0.00	4465.56	25.70	10718.25
163.91	4	8.51	42.53	0.00	6019.28	-9.49	42.53	0.00	4367.83	26.00	10387.10
164.00	4	8.51	43.30	0.00	5722.65	-9.49	43.30	0.00	4254.79	26.26	9977.44
164.07	4	8.51	43.91	0.00	5519.45	-9.49	43.91	0.00	4135.37	26.44	9654.82
164.13	4	8.51	44.52	0.00	5249.80	-9.49	44.52	0.00	4051.72	26.60	9301.52
164.18	4	8.51	44.93	0.00	5096.72	-9.49	44.93	0.00	4041.81	26.70	9138.52
164.18	4	8.51	44.94	0.00	5093.53	-9.49	44.94	0.00	4040.41	26.71	9133.94

APPENDIX 4 : Output Details of Floatation Analysis



JACKET WEIGHT PROPERTIES

OVERALL WEIGHT	4565.98	(TONNES)
CONTINGENCY FACTOR	1.05	
RESERVE BUOYANCY	17.92	%

JACKET CENTER OF GRAVITY SHIFT

JACKET X AXIS	0.00	(M)
JACKET Y AXIS	-0.65	(M)
JACKET Z AXIS	0.00	(M)

JACKET ORIENTATION AND POSITION

PITCH ANGLE	16.54	DEG.
ROLL ANGLE	-1.04	DEG.
YAW ANGLE	0.00	DEG.
MUDLINE CLEARANCE	14.94	(M)
HEIGHT ABOVE SURFACE	5.49	(M)

JACKET HYDROSTATIC PROPERTIES

CB ELEVATION	-16.12	(M)
CG ELEVATION	-14.50	(M)
JACKET BUOYANCY	4566.02	(TONNES)
FLOOD BALLAST	256.25	(TONNES)

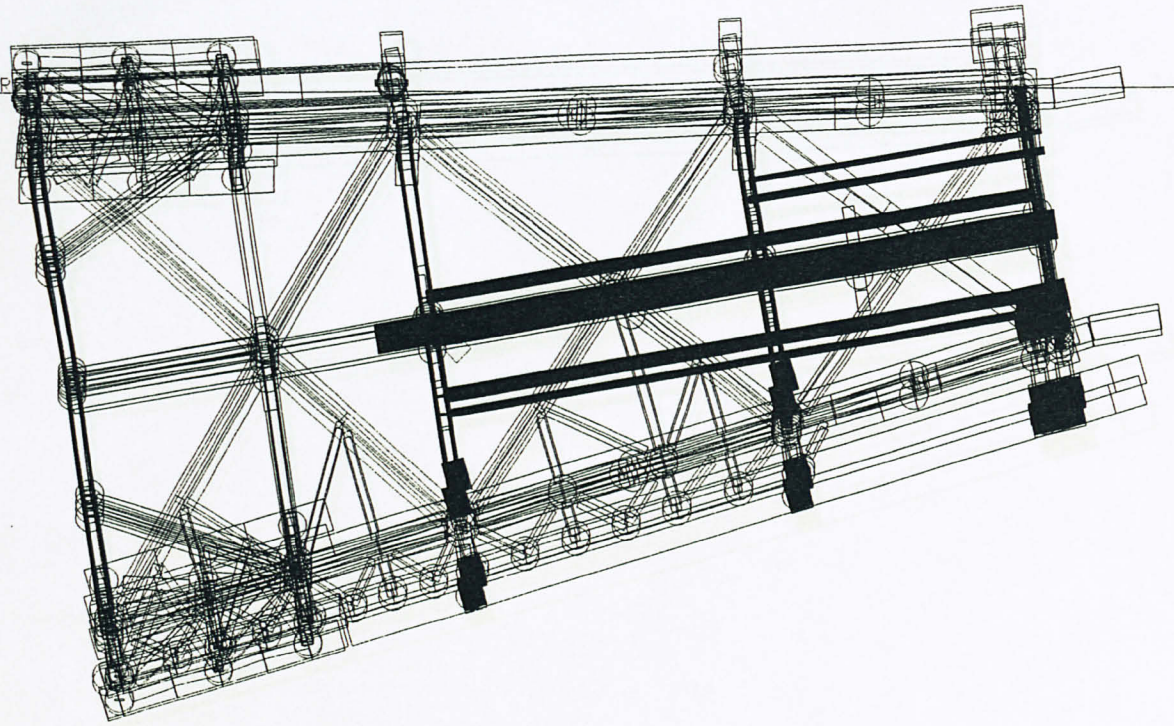
METACENTRIC PROPERTIES JACKET AND HOOK

TRANSVERSE GM	27.18	(M)
LONGITUDINAL GM	63.02	(M)
BG	1.62	(M)

⊗ CENTER OF GRAVITY
◇ CENTER OF BUOYANCY
Ⓜ METACENTER

BCP-A2 FLOTATION ANALYSIS

STEP 1 INCR 1
INITIAL POSITION



JACKET WEIGHT PROPERTIES

OVERALL WEIGHT	4696.43	(TONNES)
CONTINGENCY FACTOR	1.08	
RESERVE BUOYANCY	15.58	%

JACKET CENTER OF GRAVITY SHIFT

JACKET X AXIS	0.00	(M)
JACKET Y AXIS	-0.65	(M)
JACKET Z AXIS	0.00	(M)

JACKET ORIENTATION AND POSITION

PITCH ANGLE	16.38	DEG.
ROLL ANGLE	-1.19	DEG.
YAW ANGLE	0.00	DEG.
MUDLINE CLEARANCE	14.64	(M)
HEIGHT ABOVE SURFACE	5.22	(M)

JACKET HYDROSTATIC PROPERTIES

CB ELEVATION	-15.93	(M)
CG ELEVATION	-14.75	(M)
JACKET BUOYANCY	4693.68	(TONNES)
FLOOD BALLAST	256.25	(TONNES)

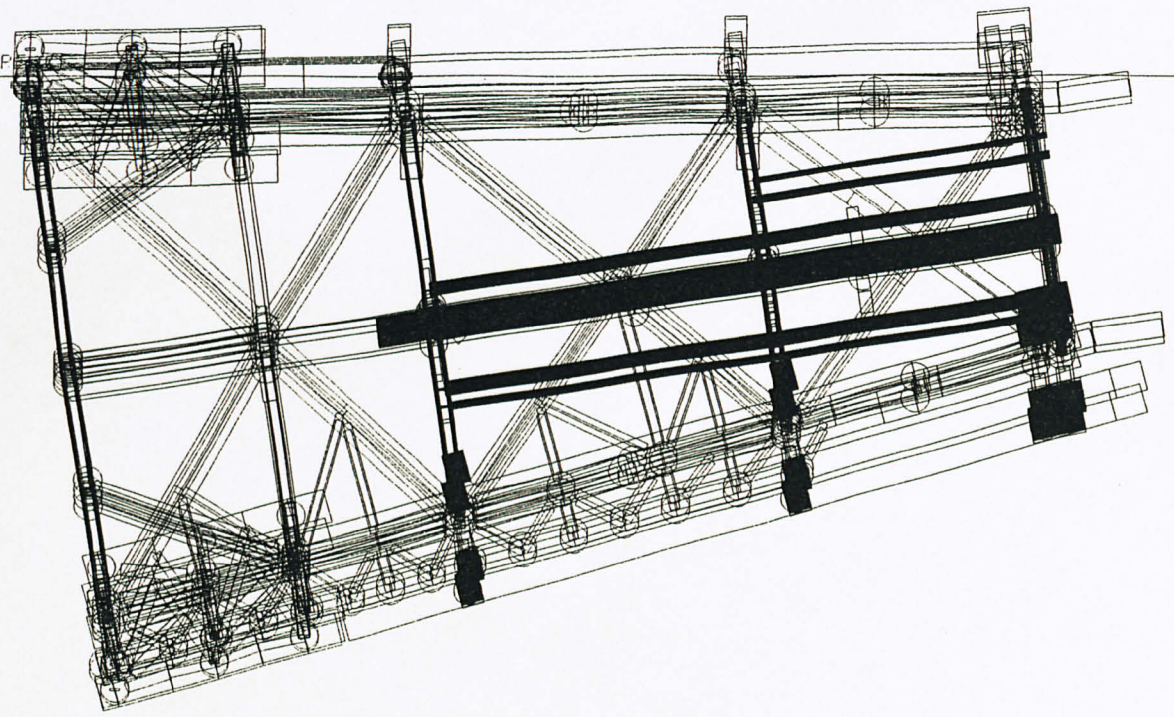
METACENTRIC PROPERTIES JACKET AND HOOK

TRANSVERSE GM	21.00	(M)
LONGITUDINAL GM	57.46	(M)
BG	1.18	(M)

⊗ CENTER OF GRAVITY
◇ CENTER OF BUOYANCY
Ⓜ METACENTER

BCP-A2 FLOTATION ANALYSIS

STEP 1 INCR 1
INITIAL POSITION



JACKET WEIGHT PROPERTIES

OVERALL WEIGHT	4913.86	(TONNES)
CONTINGENCY FACTOR	1.13	
RESERVE BUOYANCY	11.67	%

JACKET CENTER OF GRAVITY SHIFT

JACKET X AXIS	0.00	(M)
JACKET Y AXIS	-0.65	(M)
JACKET Z AXIS	0.00	(M)

JACKET ORIENTATION AND POSITION

PITCH ANGLE	15.66	DEG
ROLL ANGLE	-1.30	DEG.
YAW ANGLE	0.00	DEG.
MUDLINE CLEARANCE	14.32	(M)
HEIGHT ABOVE SURFACE	4.31	(M)

JACKET HYDROSTATIC PROPERTIES

CB ELEVATION	-15.73	(M)
CG ELEVATION	-15.28	(M)
JACKET BUOYANCY	4913.88	(TONNES)
FLOOD BALLAST	256.53	(TONNES)

METACENTRIC PROPERTIES JACKET AND HOOK

TRANSVERSE GM	21.66	(M)
LONGITUDINAL GM	34.66	(M)
BG	0.45	(M)

⊗ CENTER OF GRAVITY
◇ CENTER OF BUOYANCY
Ⓜ METACENTER

BCP-A2 FLOTATION ANALYSIS

STEP 1 INCR 1
INITIAL POSITION